

AD-A112 324

ERTEC WESTERN INC LONG BEACH CA

F/G 8/5

MX SITING INVESTIGATION GRAVITY SURVEY - PINE VALLEY, UTAH. REV--ETC(U)

MAY 81

F04704-80-C-0006

UNCLASSIFIED

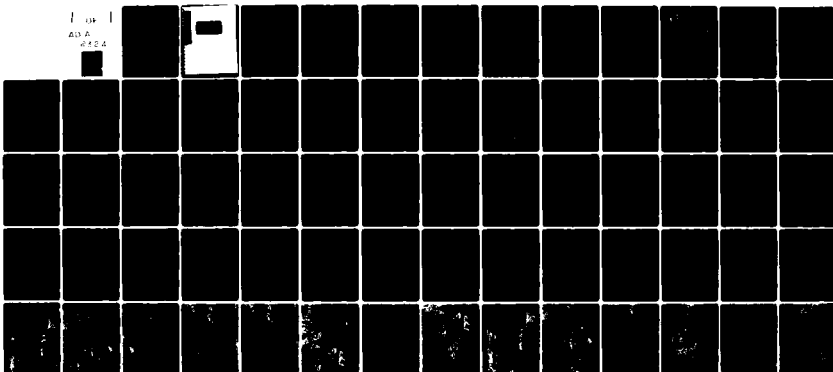
E-TR-33-PI-REV

NL

1 04 1

AD A

0122



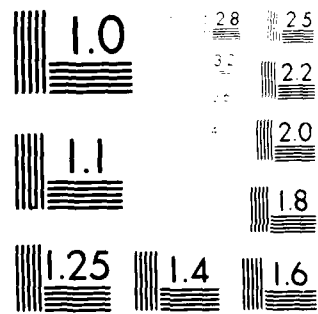
END

DATE

FILED

04-82

DTIC

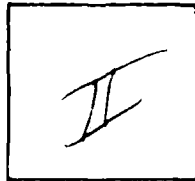


Wavelength: 633 nm (He-Ne laser)  
Aperture: 0.1 mm

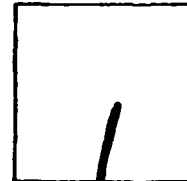
PHOTOGRAPH THIS SHEET

AD-A112 324

DTIC ACCESSION NUMBER



LEVEL



INVENTORY

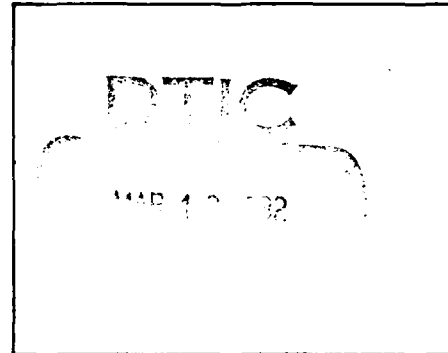
**E-TR-33-PI**  
DOCUMENT IDENTIFICATION

This document is classified "Secret" for public release. Its distribution is unlimited.

DISTRIBUTION STATEMENT

ACCESSION FOR	
NTIS	GRA&I <input checked="" type="checkbox"/>
DTIC	TAB <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DISTRIBUTION /	
AVAILABILITY CODES	
DIST	AVAIL AND/OR SPECIAL
A	

DISTRIBUTION STAMP

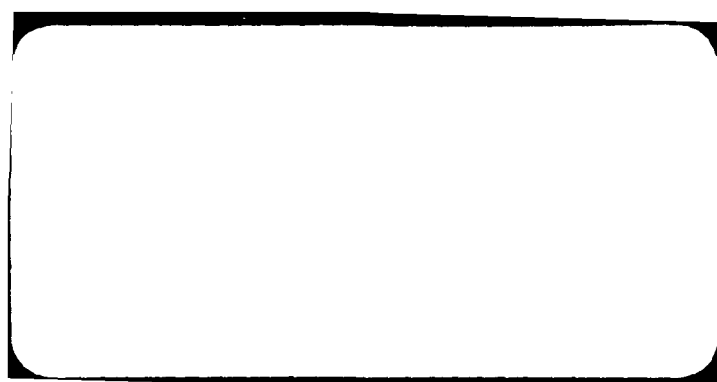


DATE ACCESSIONED



DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2



MX SITING INVESTIGATION  
GRAVITY SURVEY - PINE VALLEY  
UTAH

Prepared for:

U.S Department of the Air Force  
Ballistic Missile Office (BMO)  
Norton Air Force Base, California 92409

Prepared by:

Ertec Western, Inc.  
3777 Long Beach Boulevard  
Long Beach, California 90807

2 March 1981  
Revised  
15 May 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER <del>E-TR-33-PI</del> <del>E-TR-33-PI</del>	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Measuring Incest. Gravity Survey Pine Valley Utah		5. TYPE OF REPORT & PERIOD COVERED Final
7. AUTHOR(s) Ertec Western Inc.		6. PERFORMING ORG. REPORT NUMBER E-TR-33-PI
9. PERFORMING ORGANIZATION NAME AND ADDRESS Ertec Western Inc. (formerly Fugro National) P.O. Box 7765 Long Beach Ca 90807		8. CONTRACT OR GRANT NUMBER(s) F 04704-80-C-0006
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Department of the Air Force Space and Missile Systems Organization Vortona AFIS CA 92409 (SAMSO)		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 64312 F
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE 15 Nov 81
		13. NUMBER OF PAGES 40
		15. SECURITY CLASS. (of this report) --
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Distribution Unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)  Distribution Unlimited		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Gravity <sup>survey</sup> Geology, Bouguer Anomaly Depth to Rock, Valley Fill, Fault S, gravity profile, grabens		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Part of a gravity survey in the Pine Valley of southern Utah indicates that the main structure of the area is a series of an asymmetric fault blocks. The fault zone is separate from the western major basin boundary fault system. A major fault zone is located to the east, and the northern part of the area.		

## FOREWORD

Methodology and Characterization studies during Fiscal Years 1977 and 1978 (FY 77 and 78) included gravity surveys in ten valleys in Arizona (five), Nevada (two), New Mexico (two), and California (one). The gravity data were obtained for the purpose of estimating the gross structure and shape of the basins and the thickness of the valley fill. There was also the possibility of detecting shallow rock in areas between boring locations. Generalized interpretations from these surveys were included in Ertec Western's (formerly Fugro National) Characterization Reports (FN-TR-26a through e).

During the FY 77 surveys, measurements were made to form an approximate 1-mile grid over the study areas, and contour maps showing interpreted depth to bedrock were made. In FY 79, the decision was made to concentrate on verifying and refining suitable area boundaries. This decision resulted in a reduction in the gravity program. Instead of obtaining gravity data on a grid, the reduced program consisted of obtaining gravity measurements along profiles across the valleys where Verification studies were also performed.

The Defense Mapping Agency (DMA), St. Louis, was requested to provide gravity data from their library to supplement the gravity profiles. For Big Smoky, Hot Creek, and Big Sand Springs valleys, a sufficient density of library data was available to permit construction of interpreted contour maps instead of just two-dimensional cross sections.

In late summer of FY 79, supplementary funds became available to begin data reduction. At that time, inner zone terrain corrections were begun on the library data and the profiles from Big Smoky Valley, Nevada, and Butler and La Posa valleys, Arizona. The profile data from Whirlwind, Hamlin, Snake East, White River, Garden, and Coal valleys, Nevada, became available from the field in early October 1979.

A continuation of gravity interpretations has been incorporated into the FY 80-81 program, and the results are being summarized in a series of valley reports. Reports covering Nevada-Utah gravity studies are numbered "E-TR-33-" followed by the abbreviation for the subject valley. In addition, more detailed reports of the results of FY 77 surveys in Dry Lake and Ralston valleys, Nevada, were prepared. Verification studies were continued in FY 80 and 81, and gravity studies were included in the program. DMA continued to obtain the field measurements, and there was a return to the grid pattern. The interpretation of the grid data allows the production of contour maps which are valuable in the deep basin structural analysis needed for computer modeling in the water resources program. The

gravity interpretations will also be useful in Nuclear Hardness and Survivability (NH&S) evaluations.

The basic decisions governing the gravity program are made by BMO following consultation with TRW, Inc., Ertec Western, and the DMA. Conduct of the gravity studies is a joint effort between DMA and Ertec Western. The field work, including planning, logistics, surveying, and meter operation is done by the Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC), headquartered in Cheyenne, Wyoming. DMAHTC reduces the data to Simple Bouguer Anomaly (see Section A1.4, Appendix A1.0). The Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, Missouri, calculates outer zone terrain corrections.

Ertec Western provides DMA with schedules showing the valleys with the highest priorities. Ertec Western also recommended locations for the profiles in the FY 79 studies with the provision that they should follow existing roads or trails. Any required inner zone terrain corrections are calculated by Ertec Western prior to making geologic interpretations.

## TABLE OF CONTENTS

	<u>Page</u>
FOREWORD .....	i
1.0 INTRODUCTION .....	1
1.1 Objective .....	1
1.2 Location .....	1
1.3 Scope of Work .....	1
2.0 GRAVITY DATA REDUCTION .....	5
3.0 GEOLOGIC SUMMARY .....	6
4.0 INTERPRETATION .....	8
4.1 Regional-Residual Separation .....	8
4.2 Density Selection .....	9
4.3 Modeling .....	10
4.4 Discussion of Results .....	13
5.0 CONCLUSIONS .....	18
REFERENCES .....	19

## APPENDICES

APPENDIX

A1.0	General Principles of the Gravity Exploration Method .....	A1-1
A2.0	Pine Valley, Utah, Gravity Data .....	A2-1

## LIST OF FIGURES

Figure  
Number

1	Location Map, Pine Valley, Utah .....	2
2	Topographic Setting, Pine Valley, Utah .....	3
3	Gravity Profile AA', Interpreted Cross-Section .....	15
4	Gravity Profile BB', Interpreted Cross-Section .....	16
5	Gravity Profile CC', Interpreted Cross-Section .....	17

TABLE OF CONTENTS (cont.)

LIST OF TABLES

<u>Table Number</u>		<u>Page</u>
1	Geotechnical Data, Pine Valley, Utah .....	11
2	Borings From Literature, Pine Valley, Utah .....	12

LIST OF DRAWINGS

<u>Drawing Number</u>		
1	Complete Bouguer Anomaly Contours	
2	Depth to Rock - Interpreted from Gravity Data	In Pocket at End of Report

## 1.0 INTRODUCTION

### 1.1 OBJECTIVE

Gravity measurements were made in Pine Valley for the purpose of estimating the overall shape of the structural basin, the thickness of alluvial fill, and the location of concealed faults. The estimates will be useful in modeling the dynamic response of ground motion in the basin and in evaluating ground-water resources.

### 1.2 LOCATION

Pine Valley is located in the southwestern part of Utah (Figure 1) in Beaver and Millard counties. The town of Milford, Utah, is approximately 36 miles (58 km) east of the valley on Highway 21. Access throughout the valley is good due to an extensive network of well-maintained, unpaved roads. The valley is principally rangeland.

Pine Valley is bounded on the east by the Wah Wah Mountains and on the west by the Needle Range (Figure 2). The area covered by this report lies between North latitudes  $38^{\circ} 00'$  and  $38^{\circ} 45'$  and West longitudes  $113^{\circ} 30'$  and  $114^{\circ} 00'$ . The valley is approximately 12 miles (19 km) wide and 40 miles (64 km) long.

### 1.3 SCOPE OF WORK

A total of 439 gravity stations was used in this report. The Defense Mapping Agency Aerospace Center (DMAAC) supplied 151 gravity stations from its library, and 288 new gravity

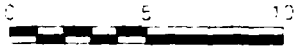


E TR 33-PI

SCALE 1:250,000



STATUTE MILES



KILOMETERS

113°30' +

38°45'

113°45' +

38°45'

113 30' +  
38 15'

113 45' +  
38 15'



**Ertec**  
The Earth Technology Corporation

MX SITING INVESTIGATION  
DEPARTMENT OF THE AIR FORCE  
BMO/AFRC-MX

TOPOGRAPHIC SETTING  
PINE VALLEY, UTAH

2 MAR 81  
15 MAY 81 REVISED

FIGURE 2

1 2

measurements were made by the Defense Mapping Agency Hydrographic Topographic Center/Geodetic Survey Squadron (DMAHTC/GSS).

Pine Valley and Wau Wau Valley were studied together, with the results presented in separate reports. The rectangular region containing both valleys is the area between North latitudes  $38^{\circ} 00'$  and  $38^{\circ} 45'$  and West longitudes  $113^{\circ} 05'$  and  $114^{\circ} 00'$ . There are 778 gravity stations in the region. All were used to establish a common regional gravity trend for the two valleys.

Following residual separation, the geologic modeling of the two valleys was done independently.

## 2.0 GRAVITY DATA REDUCTION

DMAHTC/GSS obtained the basic observations for the new stations and reduced them to Simple Bouguer Anomalies (SBA) as described in Appendix A1.0. Up to three levels of terrain corrections were applied to the new stations to convert the SBA to the Complete Bouguer Anomaly (CBA). Only the first two levels of terrain corrections described below were applied to the library stations.

First, the DMAAC, St. Louis, Missouri, used its library of digitized terrain data and a computer program to calculate corrections out to 104 miles (167 km) from each station. When the program could not calculate the terrain effects near a station, a ring template was used to estimate the effect of terrain within approximately 3000 feet (914 m) of the station. The third level of terrain corrections was applied to those stations where 10 feet (3 m) or more of relief was observed within 130 feet (40 m). In these cases, the elevation differences were measured in the field at a distance of 130 feet (40 m) along six directions from the stations. These data were used to calculate the effect of the very near relief.

### 3.0 GEOLOGIC SUMMARY

Pine Valley is a closed drainage basin that lies within the Basin and Range Physiographic Province. The rocks that crop out in the adjacent mountains range in age from early Cambrian to Tertiary.

Rocks exposed in the Wah Wah Mountains to the east are primarily north-to-northeast dipping early Cambrian to middle Ordovician sedimentary and metasedimentary quartzite and shale and middle Cambrian to Permian limestone and dolomite. Tertiary mafic to felsic lava flows and ash-flow tuffs crop out along the southeastern and southern edges of Pine Valley. The same type of Tertiary extrusive rocks are predominant in the Needle Range on the west. Tertiary intrusive quartz-monzonite crops out locally on both sides of the valley.

From late Precambrian to late Permian time, a westward thickening wedge of clastic and carbonate sediments was deposited in western Utah along a north-to-northeast trending continental shelf. Thrusting and folding began west of this region in the Jurassic and terminated to the east with late Precambrian and early Paleozoic rocks overthrusting late Paleozoic strata during the Cretaceous Sevier Orogeny (Thorman and Ketner, 1979). Early Tertiary was a time of widespread siliceous volcanism. Beginning in the Miocene, extensional block faulting began in western Utah. It was accompanied by volcanism that produced felsic and mafic-to-felsic lava flows.

The present day Pine Valley is an eastward-tilted graben whose ground-water basin is thought to be interconnected with that of Wah Wah Valley to the east (Stephens, 1976). The valley is bounded by inferred, north-trending, high-angle faults along the western side of the Wah Wah Mountains and eastern side of the Needle Range (Stephens, 1976).

The valley is underlain with uncemented to well-cemented, older Quaternary basin-fill deposits with interbedded volcanic flows (Stephens, 1976). Major surficial Quaternary deposits include fine-grained lacustrine and playa deposits, alluvial fan-gravels, eolian sand, and stream-channel deposits.

#### 4.0 INTERPRETATION

The basis of interpretation is the Complete Bouguer Anomaly (CBA). Drawing 1 shows the CBA gravity field contoured from gridded values and the location of the gravity stations.

Mathematical treatment of irregularly spaced data is inefficient. In order to simplify the computer processing, the station CBA and elevation data are reduced to sets of values at uniformly spaced points (nodes) in a geographic array, or grid. The values at each node are calculated from the station data within a circular area around the node. A bell-shaped weighting function assigns greater weight to the nearer data points. The node spacing is chosen to match the average data spacing. A 1.2-mile (2-km) grid spacing was used for this analysis.

##### 4.1 REGIONAL-RESIDUAL SEPARATION

A fundamental part of the gravity interpretation is the separation of regional effects from the local effects of the valley and its fill. The CBA contains long wavelength components from deep and broad geologic structures extending far beyond the valley. These long wavelength components, called the regional gravity, were approximated by upward continuation of the gravity field. Upward continuations were made to successively higher elevations until the negative anomaly over the valley was essentially smoothed out. The final continuation was calculated at an elevation of 140,000 feet (42,672 m). This regional field was subtracted from the CBA and the resulting residual

gravity anomaly was adjusted by a constant -5.0 milligals so that the zero residual would fit approximately the existing rock outcrops.

#### 4.2 DENSITY SELECTION

The construction of a geologic model from the residual anomaly requires selection of density values representative of the alluvial fill and of the underlying rock. Since only very generalized density information is available, the geologic interpretation of the gravity data can be only a coarse approximation. Seven borings were drilled approximately 160 feet (49 m) into the alluvium during Verification studies. The average of the densities measured at the bottom of these borings was  $2.2 \text{ g/cm}^3$ . To account for compaction with depth (Woollard, 1962; and Grant and West, 1965),  $2.3 \text{ g/cm}^3$  was used in the modeling process.

Based on the geology of the surrounding mountain ranges, the basement rocks underlying Pine Valley are composed of Precambrian quartzites and shales and Paleozoic carbonates and siliceous clastic strata. Basement rocks throughout the Great Basin primarily comprise Precambrian and Paleozoic siliceous clastic and carbonate strata with densities generally between  $2.6$  to  $2.9 \text{ g/cm}^3$ . The Paleozoic carbonate rocks in Nevada and Utah are generally reported to be relatively high in density, on the order of  $2.8 \text{ g/cm}^3$ . This value was selected to represent the density of the basement rock. The density contrast used for modeling was  $-0.50 \text{ g/cm}^3$ .

#### 4.3 MODELING

Modeling was done with the aid of a computer program which iteratively calculates a three-dimensional solution of gravity anomaly data (Cordell, 1970). The gravity anomaly is represented by discrete values on a two-dimensional grid. The source of the anomaly (the volume of low-density valley fill) is represented by a set of vertical prism elements. The tops of the prisms lie in a common horizontal plane. The bottoms of the prisms collectively represent the bottom of the valley fill. Each prism has a cross-sectional area equal to one grid square and a uniform density. A grid square of 1.2 miles by 1.2 miles (2 km by 2 km) was selected as representative of the gravity station distribution. Computations were made for five iterations of mutually interactive prism adjustments. The root-mean-square error for the entire grid was less than 0.7 milligal.

The calculated thickness of the valley fill depends upon the density contrast (i.e., fill density minus rock density) used. Since neither density is perfectly known, nor even uniform, the calculated thickness should be expected to contain a corresponding degree of uncertainty. A source of error in modeling Pine Valley as a simple alluvium basement rock system is the widespread volcanic material throughout the valley.

Eight seismic refraction lines (Table 1) and six borings (Table 2) were used as constraints in the modeling process. Their locations are marked in Drawing 2. The seismic refraction

SELECTED VERIFICATION SEISMIC REFRACTION RESULTS *			
LINE NUMBER	DEEPEST LAYER		
	$\frac{\text{fps}}{\text{(mps)}}$	@	$\frac{\text{feet}}{\text{(meters)}}$
PI - S-6	$\frac{9400}{2865}$	@	$\frac{115}{35}$
PI - S-8	$\frac{11850}{3612}$	@	$\frac{28}{9}$
PI - S-12	$\frac{9150}{2789}$	@	$\frac{90}{27}$
PI - S-13	$\frac{8250}{2515}$	@	$\frac{65}{20}$
PI - S-14	$\frac{10450}{3185}$	@	$\frac{60}{18}$
PI - S-16	$\frac{9300}{2835}$	@	$\frac{162}{49}$
PI - S-19	$\frac{10200}{3109}$	@	$\frac{110}{34}$
PI - S-21	$\frac{9350}{2850}$	@	$\frac{50}{15}$

\* LOCATIONS MARKED IN DRAWING 2.  
FROM FUGRO NATIONAL 1981



MX SITING INVESTIGATION  
DEPARTMENT OF THE AIR FORCE  
BMO/AFRCE-MX

GEOTECHNICAL DATA  
PINE VALLEY, UTAH

2 MAR 81  
15 MAY 81 REVISED

TABLE 1

I.D.	COMPANY	LOCATION	REMARKS
BORING (A)	ERTEC WESTERN PI-104	NE ¼ of SEC. 10 T26S-R17W BEAVER COUNTY, UTAH	<u>1157 FT</u> (353m) SAND AND CLAY
BORING (B)	PHELPS DODGE CORP.	SE ¼ OF SEC. 22 T28S-R17W BEAVER COUNTY, UTAH	<u>2006 FT</u> (611m) QUARTZITE
BORING (C)	PHELPS DODGE CORP.	SW ¼ OF SEC. 11 T28S-R17W BEAVER COUNTY, UTAH	<u>1305 FT</u> (398m) QUARTZITE
BORING (D)	DESERT EXPERIMENTAL RANGE	SE ¼ OF SEC. 33 T25S-R17W BEAVER COUNTY, UTAH	<u>649 FT</u> (198m) SAND ROCK
BORING (E)	A. ANDERSON	SE ¼ OF SEC. 17 T26S-R17W BEAVER COUNTY, UTAH	<u>801 FT</u> (244m) RED CLAY
BORING (F)	U.S BUREAU OF LAND MANAGEMENT	NE ¼ OF SEC. 27 T30S-R17W BEAVER COUNTY, UTAH	<u>648 FT</u> (198m) GRANITE (SOFT)

LOCATIONS MARKED IN DRAWING 2.


 MX SITING INVESTIGATION  
 DEPARTMENT OF THE AIR FORCE  
 BMO/AFRC-MX

 BORINGS FROM LITERATURE  
 PINE VALLEY, UTAH

 2 MAR 81  
 15 MAY 81 REVISED

TABLE 2

lines located near the mountain flanks recorded high velocities which may represent the basement material. The alluvial fill material in the center of the valley is at least 1157 to 2006 feet (353 to 611 m) thick according to three of the borings described in the literature. The thickness of basin fill (or depth to rock) based on the interpretation of gravity data is contoured in Drawing 2.

#### 4.4 DISCUSSION OF RESULTS

The geologic structure of Pine Valley is interpreted on the depth-to-rock contour map (Drawing 2). The interpretation is based on geologic information from published reports, analysis of aerial photographs, and geologic field reconnaissance as well as gravity data. The analysis of the gravity data included calculation of the second vertical derivative (SVD) of the CBA field. One property of the SVD is that its zero value marks the steepest gradients of the input CBA field. This property was used to guide the placement of faults in the structural interpretation. The interpreted faults represent only the major fault systems which probably comprise many smaller fault zones. There may be other discrete faults that had a minor role in basin formation, but with displacements so small that they were not resolved by the widely spaced gravity data available for this study.

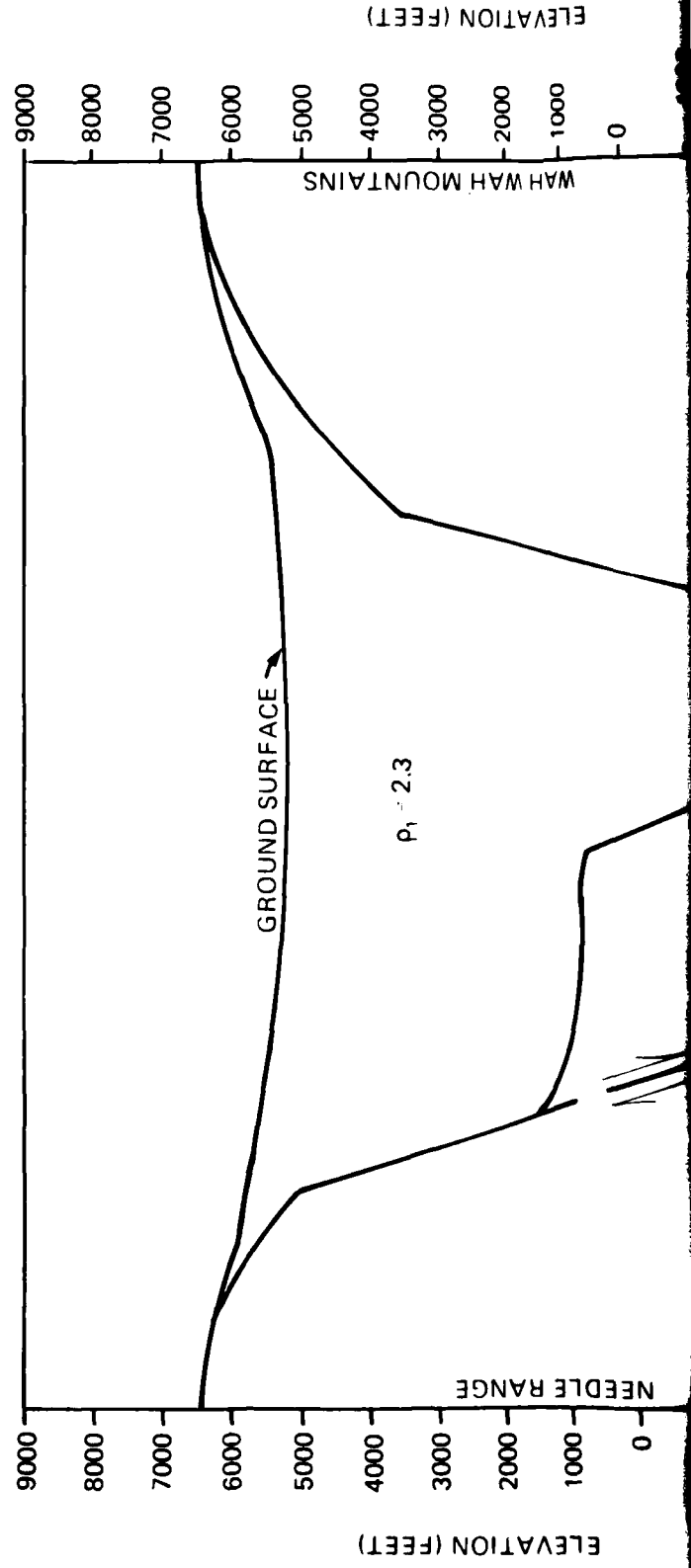
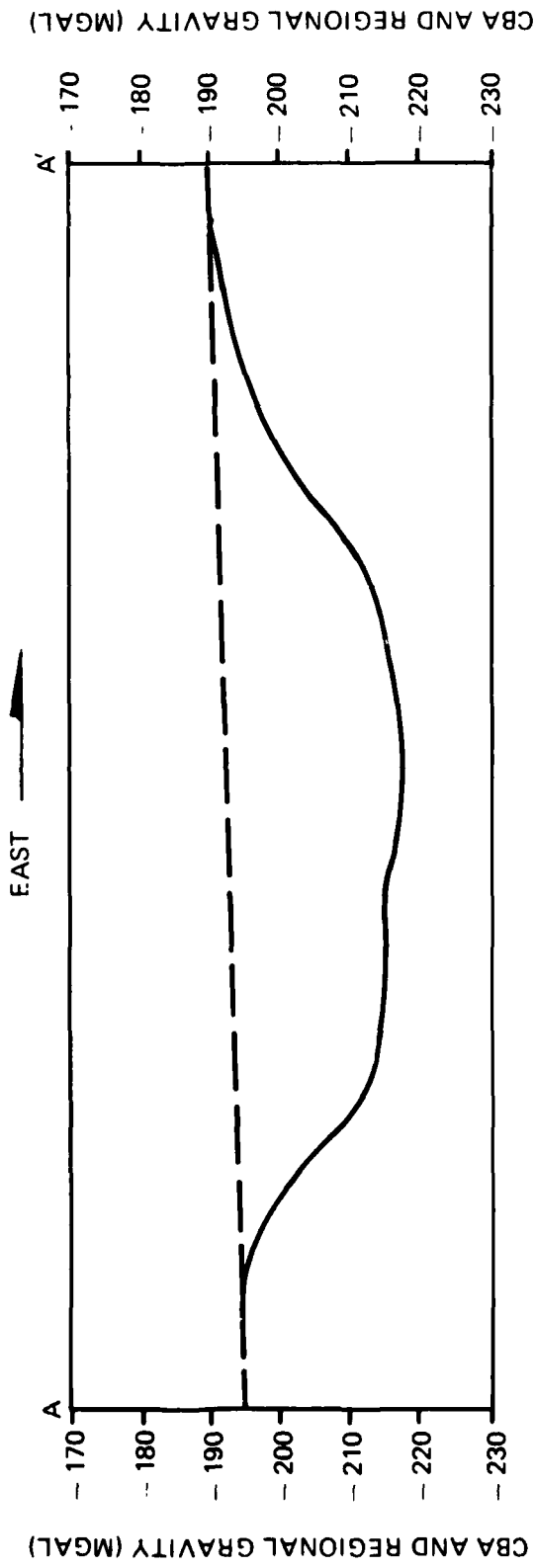
The depth-to-rock contours define a major elongate north-south trending trough coincident with the valley physiography. These contours appear to define two subsurface basins; a north-trending northern basin about 8000 feet (2438 m) deep and a

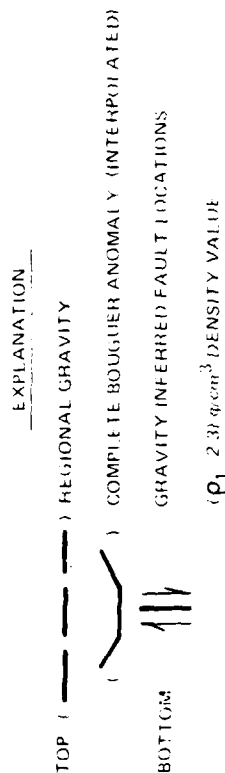
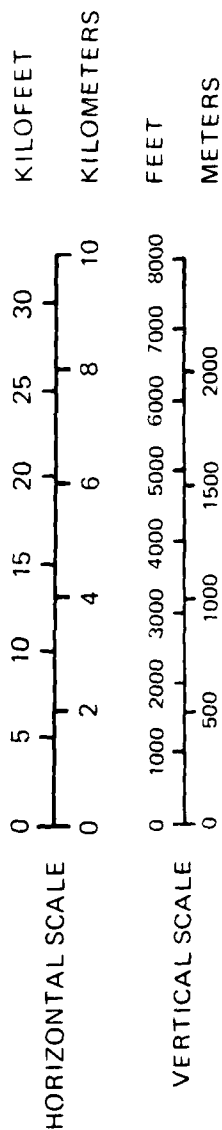
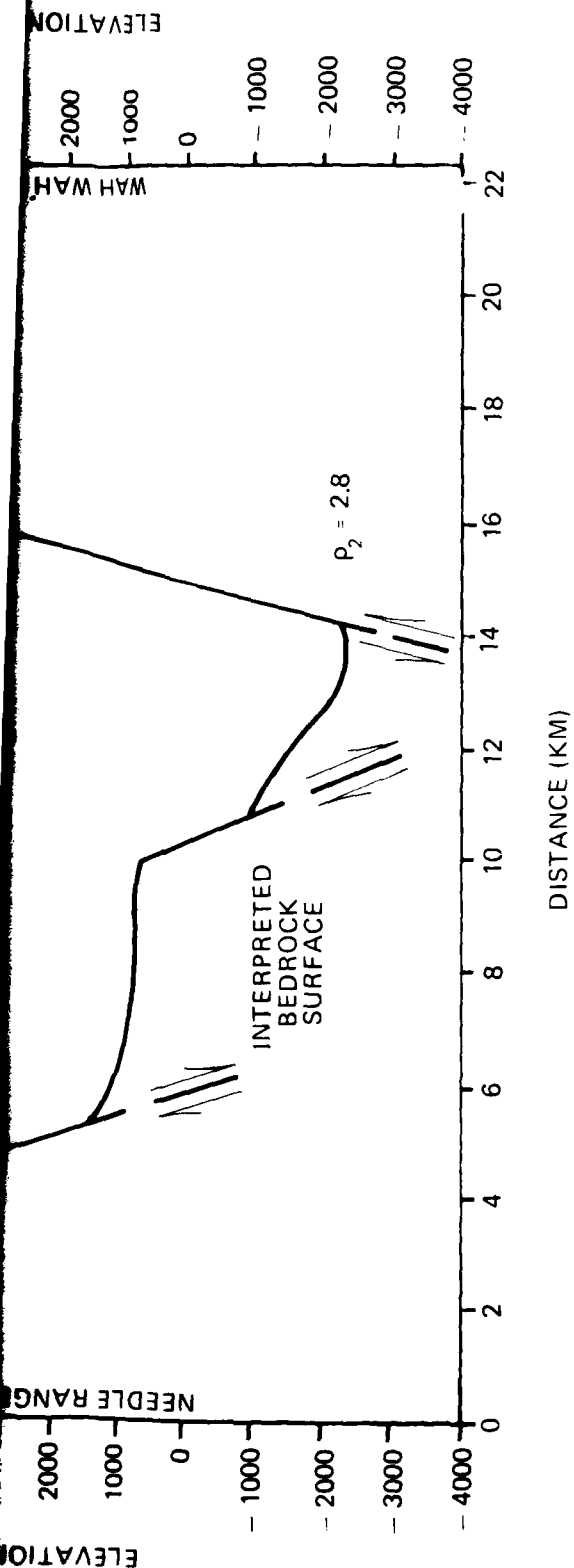
southern basin which is about 3500 feet (1067 m) deep and trends slightly west of north (Drawing 2).

The northern basin contains a major graben. The eastern side of the graben has a steep linear gradient separating it from the Wah Wah Mountains. This pattern suggests there is a continuous major fault system along the base of the Wah Wah Mountains. West of the northern end of the major graben, a complex pattern of minor steep gradients suggests an intricate arrangement of faults of varying displacements (Drawing 2, Figure 3). Farther south, in the vicinity of profile B-B' (Drawing 2, Figure 4), the smoother bedrock contours on the western side of the basin indicate that the bedrock dips gently eastward from the Needles Range for several miles before it is faulted down into the major graben.

The southern basin is more simple structurally. It is interpreted to be an eastward tilted block instead of a graben (Figure 5).

The two basins are separated by a northwesterly trending transverse fault which has allowed the northern basin to drop more deeply than the southern basin. This interpretation is in accord with studies of surficial geology and geomorphology which indicate that displacement on the eastern basin-bounding fault system diminishes southward. The fault appears to be terminated before it reaches the southern end of Pine Valley where no evidence of major fault displacements is found in Tertiary lava flows.





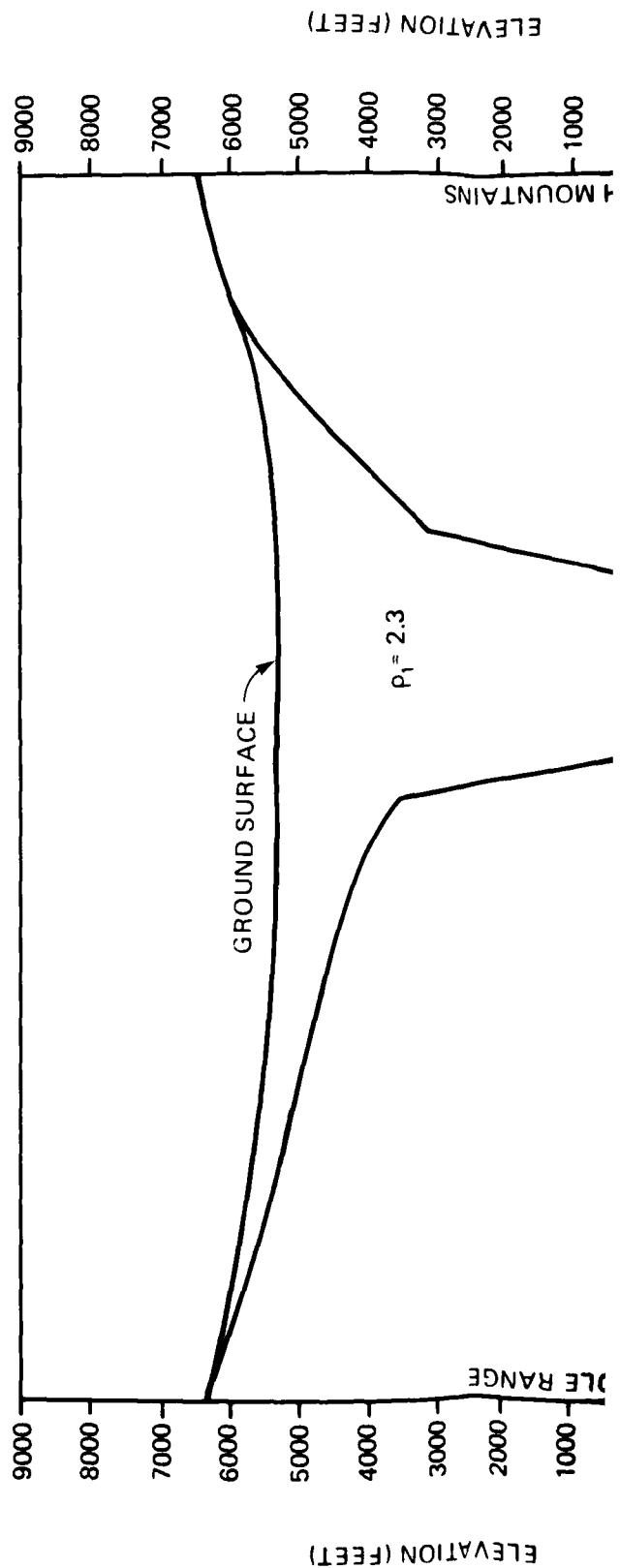
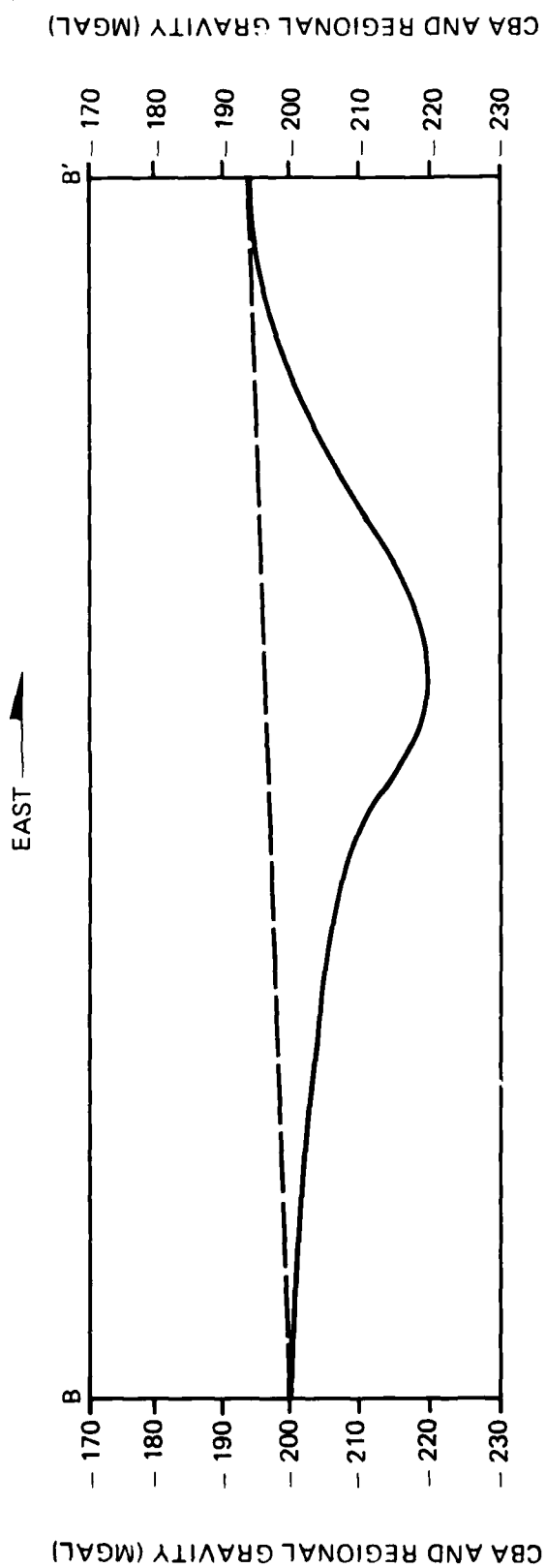
**Ertec**  
The Earth Technology Corporation

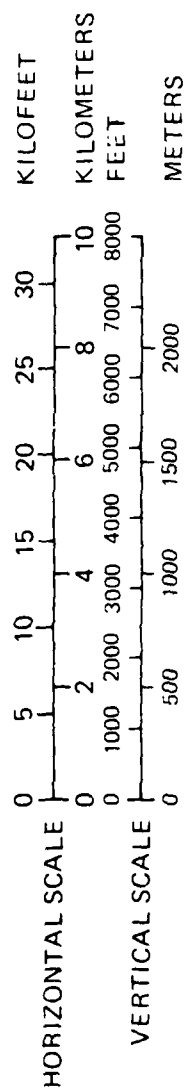
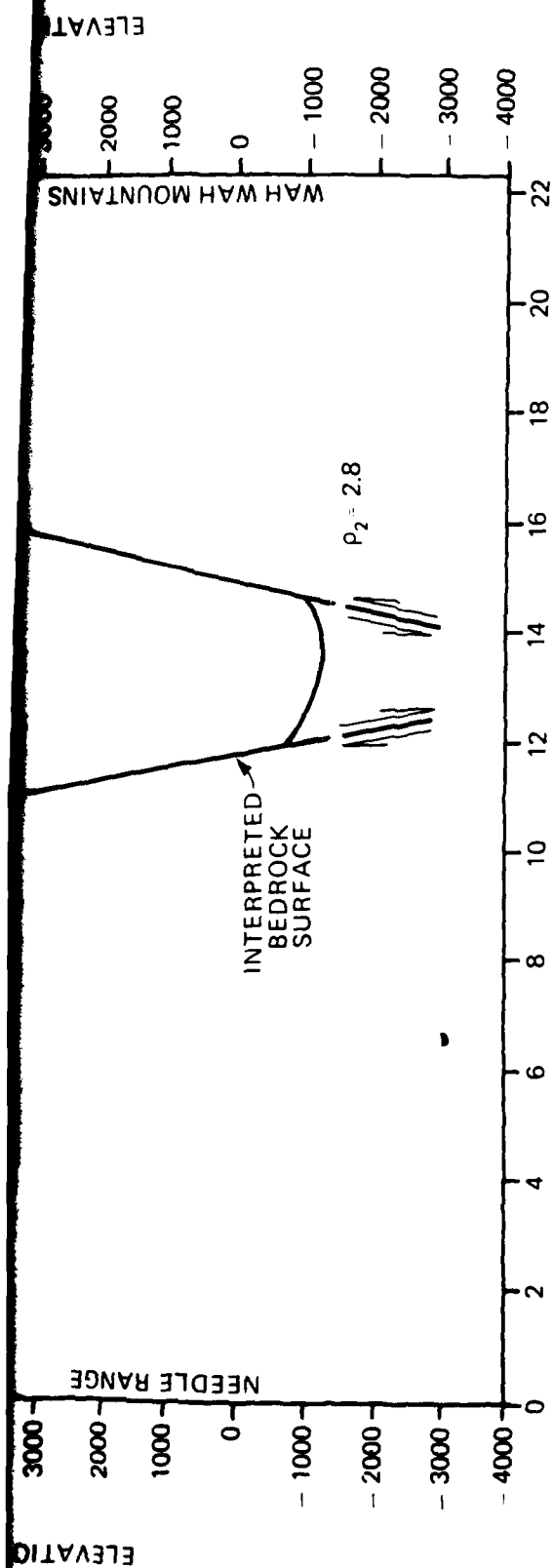
MX SITING INVESTIGATION  
DEPARTMENT OF THE AIR FORCE  
BMO/AFRC-MX

GRAVITY PROFILE A-A'  
INTERPRETED CROSS SECTION  
PINE VALLEY, UTAH

2 MAR 81  
15 MAY 81 REVISED

FIGURE 3





EXPLANATION	
TOP	(---) REGIONAL GRAVITY
BOTTOM	(---) COMPLETE BOUGUER ANOMALY (INTERPOLATED)
	(---) GRAVITY INFERRED FAULT LOCATIONS
	( $\rho_1$ ) $\rho_2$ $\rho_3$ $\rho_4$ DENSITY VALUE

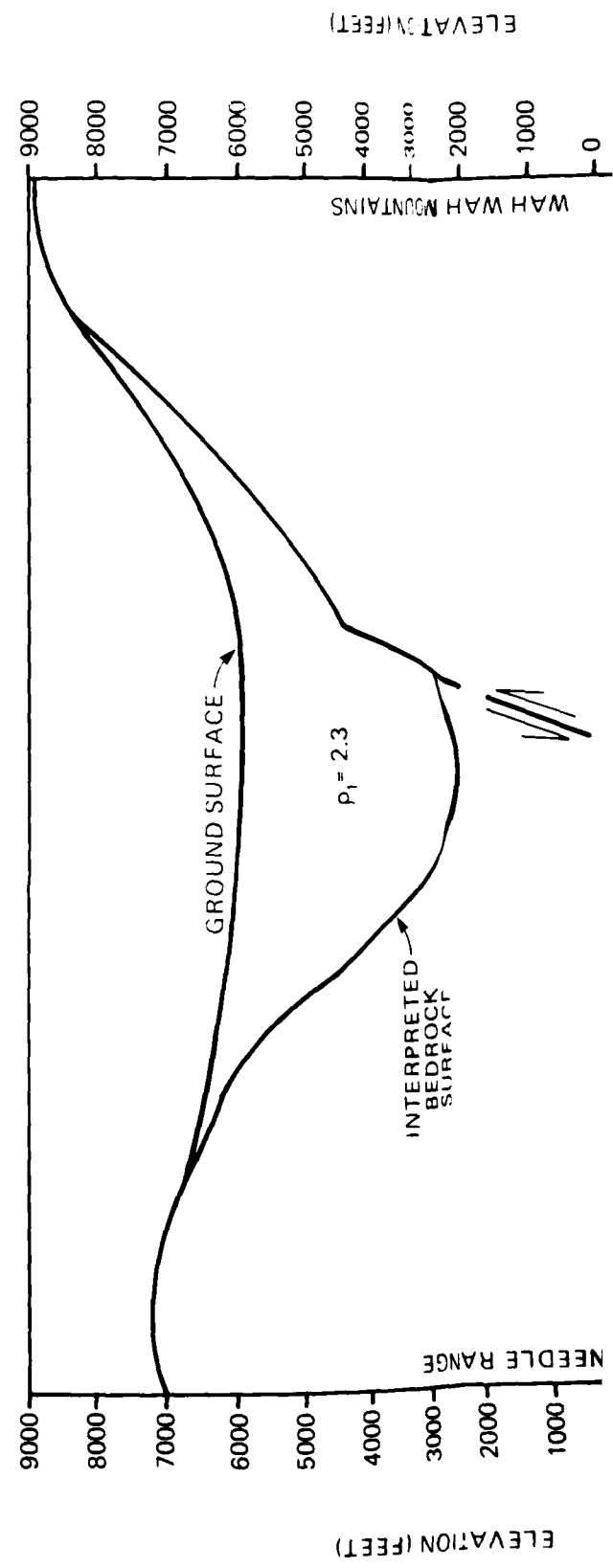
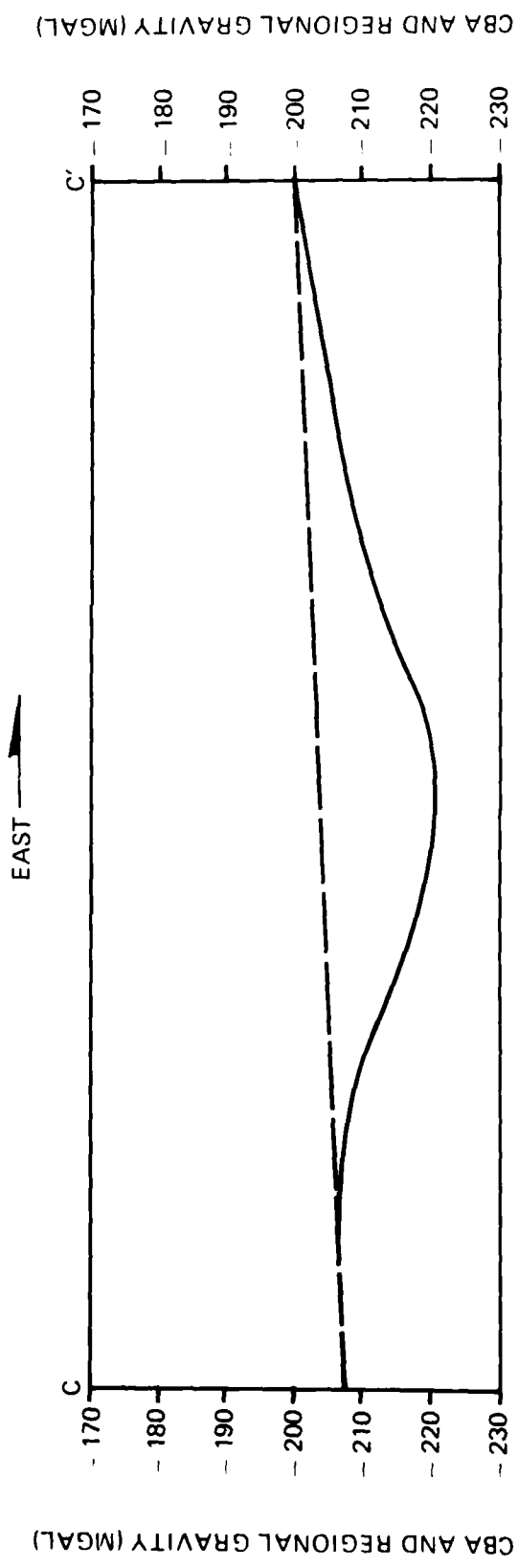
**Ertec**  
The Earth Technology Corporation

MX SITING INVESTIGATION  
DEPARTMENT OF THE AIR FORCE  
BMO/AFRC-MX

GRAVITY PROFILE B-B'  
INTERPRETED CROSS SECTION  
PINE VALLEY, UTAH

2 MAR 81  
15 MAY 81 REVISED

FIGURE 4



ELEVATION (FEET)

4000  
3000  
2000  
1000  
0  
1000  
2000  
3000  
4000

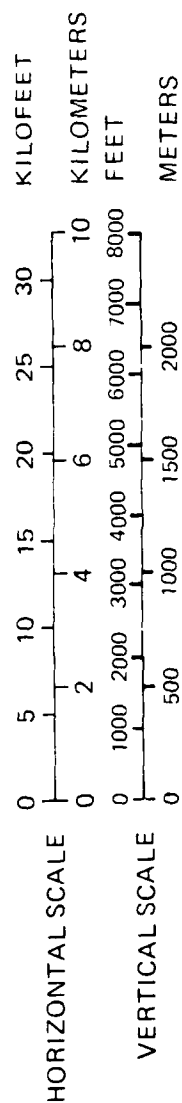
WAW WAH MOUNTAINS

 $\rho_1 = 2.3$ 

INTERPRETED  
BEDROCK  
SURFACE

 $\rho_2 = 2.8$ 

DISTANCE (KM)



## EXPLANATION

TOP ( ) REGIONAL GRAVITY  
( ) COMPLETE BOUGUER ANOMALY (INTERPOLATED)  
BOTTOM ( ) GRAVITY INFERRER FAULT LOCATIONS  
///  $(\rho_1 = 2.3 \text{ g/cm}^3 \text{ DENSITY VALUE})$

ELEVATION (FEET)

4000  
3000  
2000  
1000  
0  
1000  
2000  
3000  
4000

NEEDLE RANGE

**Ertec**  
The Earth Technology Corporation

MX SITING INVESTIGATION  
DEPARTMENT OF THE AIR FORCE  
BMO/AFRC-MX

GRAVITY PROFILE C C'  
INTERPRETED CROSS SECTION  
PINE VALLEY, UTAH

2 MAR 81  
15 MAY 81 REVISED

FIGURE 5

## 5.0 CONCLUSIONS

Pine Valley gravity data indicate that the valley occupies the down-tilted portion of an asymmetric fault block. This fault block is separated from the Wah Wah Mountains by a major basin-bounding fault system. A narrow graben, which is about 8000 feet (2438 m) deep, underlies the northern part of the valley.

The calculated bedrock depths are only approximations because little is known about the actual density distribution in and around the valley, and the residual gravity anomaly is necessarily based on an interpreted regional field. An average density contrast of  $-0.50 \text{ g/cm}^3$  between the alluvium and bedrock was used to calculate the thickness of the valley-fill material. Future studies that acquire better density data or measure actual depths to bedrock in deep parts of the valley can be used to refine the gravity interpretation.

## REFERENCES

- Cordell, Lindreth, 1970, Iterative solution of three-dimensional gravity anomaly data, Geological Survey Computer Control No. 10: U.S. Geological Survey, Washington, D.C.
- Fugro National Inc., 1981, MX Siting Investigation Geotechnical Evaluation, Verification Study - Pine Valley, Nevada, FN-TR-27-PI.
- Goguel, Jean, 1954. A universal table for the prediction of the lunar-solar correction in gravimetry (tide gravity correction), Geophysical Prospecting, v. II, Supplement, March.
- Grant, F. S., and West, G. G., 1965, Interpretation theory in applied geophysics: McGraw-Hill Book Co., New York.
- Hintze, L. F., 1963, Geologic map of Southwestern Utah; Williams and Heintz Map Co., Washington, D.C., scale of 1:250,000.
- Stephens, J. C., 1976, Hydrologic reconnaissance of the Pine Valley Drainage Basin, Millard, Beaver and Iron counties, Utah: Technical Publication No. 51, Department of Natural Resources, State of Utah p. 38.
- Thorman, E. H., and Ketner, K. B., 1979, West-Northwest strike-slip faults and other structures in allochthonous rocks in Central and Eastern Nevada and Western Utah; in Basin and Range symposium, by the Rocky Mountain Association of Geologists and Utah Geological Association, p. 12-133.
- Woollard, G. P., 1962, The relation of gravity anomalies to surface elevation, crustal structure, and geology: University of Wisconsin, Department of Geology, Geophysical and Polar Research Center, Madison, Wisconsin, Report 62-9.

APPENDIX A1.0

GENERAL PRINCIPALS OF THE  
GRAVITY EXPLORATION METHOD

A1.0 GENERAL PRINCIPALS OF THE GRAVITY  
EXPLORATION METHOD

A1.1 GENERAL

A gravity survey involves measurement of differences in the gravitational field between various points on the earth's surface. The gravitational field values being measured are the same as those influencing all objects on the surface of the earth. They are generally associated with the force which causes a 1-gm mass to be accelerated at  $980 \text{ cm/sec}^2$ . This force is normally referred to as a 1-g force.

Even though in many applications the gravitational field at the earth's surface is assumed to be constant, small but distinguishable differences in gravity occur from point to point. In a gravity survey, the variations are measured in terms of milligals. A milligal is equal to  $0.001 \text{ cm/sec}^2$  or  $0.00000102 \text{ g}$ . The differences in gravity are caused by geometrical effects, such as differences in elevation and latitude, and by lateral variations in density within the earth. The lateral density variations are a result of changes in geologic conditions. For measurements at the surface of the earth, the largest factor influencing the pull of gravity is the density of all materials between the center of the earth and the point of measurement.

To detect changes produced by differing geological conditions, it is necessary to detect differences in the gravitational field as small as a few milligals. To recognize changes due to

geological conditions, the measurements are "corrected" to account for changes due to differences in elevation and latitude.

Given this background, the basic concept of the gravitational exploration method, the anomaly, can be introduced. If, instead of being an oblate spheroid characterized by complex density variations, the earth were made up of concentric, homogeneous shells, the gravitational field would be the same at all points on the surface of the earth. The complexities in the earth's shape and material distribution are the reason that the pull of gravity is not the same from place to place. A difference in gravity between two points which is not caused by the effects of known geometrical differences, such as in elevation, latitude, and surrounding terrain, is referred to as an "anomaly."

An anomaly reflects lateral differences in material densities. The gravitational attraction is smaller at a place underlain by relatively low density material than it is at a place underlain by a relatively high density material. The term "negative gravity anomaly" describes a situation in which the pull of gravity within a prescribed area is small compared to the area surrounding it. Low-density alluvial deposits in basins such as those in the Nevada-Utah region produce negative gravity anomalies in relation to the gravity values in the surrounding mountains which are formed by more dense rocks.

The objective of gravity exploration is to deduce the variations in geologic conditions that produce the gravity anomalies identified during a gravity survey.

## A1.2 INSTRUMENTS

The sensing element of a LaCoste and Romberg gravimeter is a mass suspended by a zero-length spring. Deflections of the mass from a null position are proportional to changes in gravitational attraction. These instruments are sealed and compensated for atmospheric pressure changes. They are maintained at a constant temperature by an internal heater element and thermostat. The absolute value of gravity is not measured directly by a gravimeter. It measures relative values of gravity between one point and the next. Gravitational differences as small as 0.01 milligal can be measured.

## A1.3 FIELD PROCEDURES

The gravimeter readings were calibrated in terms of absolute gravity by taking readings twice daily at nearby USGS gravity base stations. Gravimeter readings fluctuate because of small time-related deviations due to the effect of earth tides and instrument drift. Field readings were corrected to account for these deviations. The magnitude of the tidal correction was calculated using an equation suggested by Goguel (1954):

$$C = P + N \cos \phi (\cos \phi + \sin \phi) + S \cos \phi (\cos \phi - \sin \phi)$$

where C is the tidal correction factor, P, N, and S are time-related variables, and  $\phi$  is the latitude of the observation point. Tables giving the values of P, N, and S are published annually by the European Association of Exploration Geophysicists.

The meter drift correction was based on readings taken at a designated base station at the start and end of each day. Any difference between these two readings after they were corrected for tidal effects was considered to have been the result of instrumental drift. It was assumed that this drift occurred at a uniform rate between the two readings. Corrections for drift were typically only a few hundredths of a milligal. Readings corrected for tidal effects and instrumental drift represented the observed gravity at each station. The observed gravity values represent the total gravitational pull of the entire earth at the measurement stations.

#### A1.4 DATA REDUCTION

Several corrections or reductions are made to the observed gravity to isolate the portion of the gravitational pull which is due to the crustal and near-surface materials. The gravity remaining after these reductions is called the "Bouguer Anomaly." Bouguer Anomaly values are the basis for geologic interpretation. To obtain the Bouguer Anomaly, the observed gravity is adjusted to the value it would have had if it had been measured at the geoid, a theoretically defined surface which approximates the surface of mean sea level. The difference between the "adjusted" observed gravity and the gravity at the geoid calculated for a theoretically homogeneous earth is the Bouguer Anomaly.

Four separate reductions, to account for four geometrical effects, are made to the observed gravity at each station to arrive at its Bouguer Anomaly value.

a. Free-Air Effect: Gravitational attraction varies inversely as the square of the distance from the center of the earth. Thus, corrections must be applied for elevation. Observed gravity levels are corrected for elevation using the normal vertical gradient of:

$$FA = -0.09406 \text{ mg/ft } (-0.3086 \text{ milligals/meter})$$

where FA is the free-air effect (the rate of change of gravity with distance from the center of the earth). The free-air correction is positive in sign since the correction is opposite the effect.

b. Bouguer Effect: Like the free-air effect, the Bouguer effect is a function of the elevation of the station, but it considers the influence of a slab of earth materials between the observation point on the surface of the earth and the corresponding point on the geoid (sea level). Normal practice, which is to assume that the density of the slab is 2.67 grams per cubic centimeter was followed in these studies. The Bouguer correction ( $B_C$ ), which is opposite in sign to the free-air correction, was defined according to the following formula.

$$B_C = 0.01276 (2.67) h_f \text{ (milligals per foot)}$$

$$B_C = 0.04185 (2.67) h_m \text{ (milligals per meter)}$$

where  $h_f$  is the height above sea level in feet and  $h_m$  is the height in meters.

c. Latitude Effect: Points at different latitudes will have different "gravities" for two reasons. The earth (and the geoid) is spheroidal, or flattened at the poles. Since points at higher latitudes are closer to the center of the earth than points near the equator, the gravity at the higher latitudes is larger. As the earth spins, the centrifugal acceleration causes a slight decrease in gravity. At the higher latitudes where the earth's radii are smaller, the centrifugal acceleration diminishes. The gravity formula for the Geodetic Reference System, 1967, gives the theoretical value of gravity at the geoid as a function of latitude. It is:

$$g = 978.0381 (1 + 0.0053204 \sin^2 \phi - 0.0000058 \sin^2 2\phi) \text{ gals}$$
where  $g$  is the theoretical acceleration of gravity and  $\phi$  is the latitude in degrees. The positive term accounts for the spheroidal shape of the earth. The negative term adjusts for the centrifugal acceleration.

The previous two corrections (free air and Bouguer) have adjusted the observed gravity to the value it would have had at the geoid (sea level). The theoretical value at the geoid for the latitude of the station is then subtracted from the adjusted observed gravity. The remainder is called the Simple Bouguer Anomaly (SBA). Most of this gravity represents the effect of material beneath the station, but part of it may be due to irregularities in terrain (upper part of the Bouguer slab) away from the station.

d. Terrain Effect: Topographic relief around the station has a negative effect on the gravitational force at the station. A nearby hill has upward gravitational pull and a nearby valley contributes less downward attraction than a nearby material would have. Therefore, the corrections are always positive. Corrections are made to the SBA when the terrain effects were 0.1 milligal or larger. Terrain corrected Bouguer values are called the Complete Bouguer Anomaly (CBA). When the CBA is obtained, the reduction of gravity at individual measurement points (stations) is complete.

#### A1.5 INTERPRETATION

To interpret the gravity data, the portion of the CBA that might be caused by the light-weight, basin-fill material must be separated from that caused by the heavier bedrock material which forms the surrounding mountains and presumably the basin floor. The first step is to create a regional field. A regional field is an estimation of the values the CBA would have had if the light-weight sediments (the anomaly) had not been there. Since the valley-fill sediments are absent at the stations read in the mountains, one approach is to use the CBA values at bedrock stations as the basis for constructing a second order polynomial surface to represent a regional field over the valley.

Where there are insufficient bedrock stations to define a satisfactory regional trend, another approach is to estimate the regional by the process of upward continuation of the CBA field.

In Potential Theory, a field normal to a surface, regardless of its actual source, may be considered as originating in an areal distribution of mass on that surface. If the field strength is known the surface density of mass (grams per square centimeter) can be calculated. The observed gravity field at the surface of the earth approximately fulfills the requirements of this theory: thus the observed (Bouguer anomaly) field can be used to compute a surficial distribution of mass which would reproduce the field, and most importantly, account for the gravity field anywhere above the surface of observation. On this basis, the Bouguer anomaly field is readily "continued" to level surfaces above the ground.

An important property of such "upward continuation" is that the resultant field (which can be represented by a contour map), with increasing altitudes of continuation, changes more with respect to shallow sources than it does with respect to deeper sources. The anomalous parts of the field ascribed to shallow density distribution tend to vanish as the continuation is carried upward whereas the field produced by deeper sources changes only slightly, so that upward continuations produce "regional"-type fields.

The difference between the CBA and the regional field is called the "residual" field or residual anomaly. The residual field is the interpreter's estimation of the gravitational effect of the geologic anomaly. The zero value of the residual anomaly is not exactly at the rock outcrop line but at some distance on the

"rock" side of the contact. The reason for this is found in the explanation of the terrain effect. There is a component of gravitational attraction from material which is not directly beneath a point.

If the "regional" is well chosen, the magnitude of the residual anomaly is a function of the thickness of the anomalous (fill) material and the density contrast. The density contrast is the difference in density between the alluvial and bedrock material. If this contrast were known, an accurate calculation of the thickness could be made. In most cases, the densities are not well known and they also vary within the study area. In these cases, it is necessary to use typical densities for materials similar to those in the study area.

If the selected average density contrast is smaller than the actual density contrast, the computed depth to bedrock will be greater than the actual depth and vice-versa. The computed depth is inversely proportional to the density contrast. A ten percent error in density contrast produces a ten percent error in computed depth. An iterative computer program is used to calculate a subsurface model which will yield a gravitational field to match (approximately) the residual gravity anomaly.

The second vertical derivative (SVD) of gravitational field is used to aid the interpreter in evaluating the subsurface mass distribution. Once the CBA field has been projected onto a uniform grid system, its SVD at the grid nodes is readily computed.

In accordance with La Place's Equation in Free Space, the negative of the second vertical derivative is equal to the sums of the second derivatives in the x-direction and in the y-direction. The second vertical derivative is an indication of the curvature of the Bouguer anomaly field. In particular the zero-value of the SVD indicates the inflection in the field as it changes from "concave-upward" (algebraically negative SVD) to "convex-upward" (algebraically positive SVD). In a general way the zero SVD falls on the tightest contours of the field and where contours are nearly parallel its location can be established by eye. However, where contours diverge, converge, or change direction this is not always so readily done. The zero SVD contour line may be an indicator of a line of faulting, the pinchout of a stratum, truncation of a stratum at an unconformity or merely a marked change in shape or in density of a geologic unit.

APPENDIX A2.0  
PINE VALLEY, UTAH  
GRAVITY DATA

## PINE VALLEY GRAVITY DATA

STATION IDENT.	LAT DEG MIN	LONG DEG MIN	ELEV +CODE	REF-CODE IN/OUT	NORTH UTM	EAST UTM	DBS GRAV	THEO GRAV	FAA	CSA +1000
HV0912	381758	1135958	62528	O	161424258	23824143693201798	-262	78575		
HV0913	381825	1135960	64528	O	175424331	23869141977201532	855	79022		
HV0914	381831	1135790	66528	O	156424420	24074141451201920	2139	79648		
HV0915	381829	1135726	68148	O	312424493	24170141247201975	3407	80379		
HV0916	381917	1135744	69298	O	254424549	24291140719202016	3923	80544		
HV0917	381922	1135572	72628	O	340424674	24400138348202112	4639	80191		
HV0918	382013	1135528	74958	O	257424825	24469136864202230	5086	79545		
HV0919	382079	1135435	71158	O	260424896	24606139080202294	3766	79755		
HV0920	382105	1135410	70558	O	206424906	24643139525202352	3637	79782		
HV0921	382112	1135382	70358	O	152424922	24684139743202302	3652	79852		
HV0922	382120	1135356	69638	O	191424938	24722140158202314	3378	79522		
HV0923	382129	1135331	69108	O	186424956	24759140478202227	3191	79809		
HV0924	382140	1135308	68648	O	176424978	24973140759202242	3020	79795		
HV0925	382132	1135284	68168	O	171425001	24829141128202361	2917	79842		
HV0926	382157	1135265	67558	O	167425030	24858141350202383	2744	79872		
HV0927	382183	1135246	67188	O	166425060	24886141849202406	2674	79927		
HV0928	382201	1135227	66678	O	164425095	24915142237202433	2545	79970		
HV0929	382216	1135211	66858	O	159425123	24939142141202455	2534	79582		
U733	381248	1134574	67198	O	173423230	23513139410201036	1570	78843		
4686	381249	1134032	61877	O	139423244	26649142093301067	-760	78278		
U734	381226	1134875	71270	O	246423317	25372137210201095	3140	79096		
67	381250	1134270	63319	O	127423294	26269140833201099	-800	77777		
65	381035	1135165	63292	O	485423361	24954131769201120	6160	79285		
U702	381431	1134087	61289	O	145423547	26534142701201304	-946	78235		
U701	381273	1134195	69977	O	166423925	26402143572201600	-1000	78206		
4701	381675	1134186	69797	O	175424003	26403143692201662	-1710	78375		
4702	381610	1134464	61219	O	136424246	26004142781201845	-1370	77846		
U662	381837	1134729	68009	O	214424464	24165141252211973	3240	80274		
U700	381534	1134275	69740	O	157424576	26264144719202115	-2130	77967		
4703	382015	1134262	69997	O	166424634	26325145527202160	-2050	78316		
U659	382048	1135155	75420	O	264424753	24453135133202209	4850	79405		
U691	382156	1134249	61177	O	162424982	253181441911202382	2071	80372		
U690	382198	1134143	66517	O	168425112	25037142177202425	2350	79638		
4706	382206	1134586	69027	O	140425002	25846144475202440	-540	78670		
4707	382232	1134395	68967	O	132425121	26209144877202464	-2550	78072		
U692	382222	1134066	69307	O	200425028	26505143404202479	-1900	78510		
U699	382245	1134232	69277	O	154425059	26366147151202495	-2520	78424		
4704	382216	1134116	69377	O	183425172	26620148491202514	-1570	78632		
U693	382253	1134709	69497	O	124425261	25663145488202641	-710	79134		
68	382400	1134170	69697	O	128425355	26467147564202769	-2850	78298		
4700	382445	1134174	69637	O	127425426	26462147593202791	-2950	78277		

## FINE VALLEY GRAVITY DATA

STATION IDENT.	LAT DEG MIN	LONG DEG MIN	ELEV +0000	TEMP-COR IN/OUT	NORTH UTM	EAST UTM	GRSV GRAV	THEO GRAV	FAA	CSA +1000
U-92	382816	1134463552897	0	113435570	26042147772202885	-3120	78752			
U-94	382810	1134273144007	0	108425823	26329148663203107	-3260	78252			
U-95	382812	1134075532127	0	108426194	26622149429300403	-3390	78058			
4299	382815	1134065533407	0	108426199	26643149419303407	-3810	78102			
001	383010	1133003358767	0	240426423	28199150700303620	-350	80530			
000	383040	1133730555557	0	171426808	27139150480303664	-900	80311			
001	383100	1133190611257	0	377426597	27927147940203753	1580	81127			
000	383130	1132930523117	0	127426623	26852151380303753	-3150	79141			
2351	383112	1133443643117	0	267426630	27654145933213770	2620	80969			
2352	383141	1133912555557	0	191426703	26820150445203913	-1090	80151			
000	383290	1134290912737	0	103426994	26339151190304032	-4040	78360			
2352	383331	1134437524877	0	104427077	26125151554304092	-2080	79136			
0735	383404	11344609539507	0	109427219	25592151446304159	-1970	79739			
000	383490	11348809575077	0	139427490	25473145431204325	-290	80232			
2354	383510	11349409575077	0	139427407	25592149-212043940	-310	80205			
1104	383528	1134431515297	0	103427441	26147151541204321	-3920	78403			
9002	383530	11344209524877	0	107427502	26078151244204428	-3200	78407			
0744	383532	11344995324907	0	109427545	26055151322204462	-3760	78449			
0736	383535	1134995531807	0	139427608	25331146325204454	530	80519			
000	383600	11349909571817	0	147427635	253551493903204516	520	80507			
0738	383722	1135341434887	0	143427840	24837146933204566	1990	80495			
2355	383710	1135090612607	0	147427915	25204147861204737	550	79897			
0737	383797	1135147615467	0	126427970	25123147940304777	1050	80196			
0742	383915	1134596528997	0	126428256	25932151369305024	-2950	78799			
000	383930	1135300604687	0	126428316	24812149150305046	980	80491			
89	384110	1135355997057	1	112428540	24946150503205222	1420	81202			
1107	384113	1134155514817	1	122428552	26391152236101374	-2740	79158			
89	384130	1135060567567	0	117428678	25270149416205310	-810	79347			
0742	384147	1134930596677	0	107428645	25459149230305321	410	80077			
0740	384172	1134289941597	0	113428677	24737150633305328	1190	81122			
2356	384212	1135420590617	0	124428735	24644151456205372	700	81044			
2355	384213	1135110599917	1	118428443	25259150335520594	20	81395			
0741	384230	1135355991447	1	119428492	24867151470205497	600	80922			
0741	384239	1135311566417	0	1264289051	24484152014205619	-330	80762			
P00162	384575	113415551081	0	116428071	26567152474214891	-3845	78851			
P00163	384575	113417551651	0	116428020	262461521734204691	-3551	78942			
P00109	384515	1135149510329	21	459414727	250111411091909466	4944	81037			
P00179	384575	1135149510329	44	299442731	27525152114219684	8403	80742			
P00125	384544	1135149510329	34	299442443	25203172174202169	4656	79126			
P00274	384511	1135149510329	0	134428212	27263141696200564	194	79016			
P00217	384512	1135149510329	46	677428632	27494192045201393	6627	80152			

## PINE VALLEY GRAVITY DATA

STATION IDENT	LAT. DEG MIN	LONG DEG MIN	ELEV +CODE	TER-DOF IN/OUT	NORTH UTM	EAST UTM	OBS. GRAV	THEO GRAV	FAA	CGF +1000
WV0074	383876	1133156	59709	0	312428032	28013149987204882			1282	81232
WV0080	383879	1133316	8685V	0	312015428184	27730128428203427			7908	81234
WV0142	383710	1133310	86550	0	312709428581	27733129540203180			7933	81162
WV0145	383750	1133159	62030	25	463427872	28007144739204766			4004	81282
WV0146	383850	1133100	70368	30	611427426	28051142178204413			3990	80633
WV0077	383335	1133128	60910	14	298425217	27980146235302659			903	80440
WV0078	383406	1133139	63870	9	506425582	27976145063200027			2168	80900
WV0142	383548	1133098	66500	1	511428122	28048143751303377			2563	80794
PV0110	384420	1133353	74375	30	358425513	24984128394203023			5224	80146
PV0111	384377	1133204	68908	51	208425546	24954141312202691			3471	80230
PV0122	382773	1133596	63451	7	341426009	27320145215203272			1664	80371
PV0227	381717	1134906	72228	25	367424112	25355136874201733			3128	78825
PV0231	382216	1135040	70715	41	409425059	25189140141202470			4226	80555
PV0241	381316	1134804	71010	37	226423325	25483136906201135			2608	78662
PV0252	384426	1133725	61367	4	165423098	27031135588200189			1046	78926
PV0206	384402	1134111	64150	3	1744231645	26444140053157798			634	78931
PV0310	38702	1134443	67760	1	177423214	25975135488200237			2028	79095
PV0321	381903	1133804	86822	4	1315424408	26972127638201995			7370	79120
PV0322	382184	1133740	74667	11	621424944	27080136943202423			4795	80032
PV0323	382551	1133621	62560	30	458415637	27186145039203990			928	80079
PV0324	382127	1133638	73780	32	559425130	27234137301202573			4173	79953
PV0325	384900	1134860	75520	6	412422598	25376134521200627			5079	79740
PV0375	381163	1133817	64575	3	141423040	26914141518200911			1473	79560
PV0291	381148	1133343	70825	4	255422993	27605138083200889			3552	79956
PV0318	38738	1132232	65175	11	269422321	27793138838201363			3580	80269
PV0044	382734	1133623	53040	0	325427995	27044138960204763			-1886	80245
PV0048	384127	1133732	56550	0	134425027	26918151208205659			-738	80074
PV0052	383702	1133934	51010	0	174427741	26879152956204627			-3666	79110
PV0054	382126	1132943	51850	0	126427046	26845132644204084			-2644	79807
PV0061	382962	1134044	51741	0	132428217	26733152576203019			-3751	78734
PV0063	384311	1134043	55121	0	137426873	26753152261716532			-1387	79947
PV0065	384057	1134133	53167	0	142428075	26558150584216559			-42	80360
PV0066	384723	1134167	54901	0	131428714	26582151768217412			-1925	79457
PV0067	384048	1134132	53431	0	124428391	26951152393201115			-3254	78935
PV0069	383702	1134155	50761	0	112427751	26557151473216627			-4294	78416
PV0070	383528	1134155	51251	0	105427429	26549151451204321			-4495	78126
PV0071	383316	1134161	51650	0	100427056	26538150516214094			-4465	77947
PV0072	383152	1134151	52221	0	101427136	26514150135217528			-4326	77941
PV0075	382712	1134214	51741	0	112428236	264414152167219319			-3619	78632
PV0080	384510	1134264	52461	0	157428820	26433150305205550			-205	80042
PV0086	383702	1134377	50860	0	111427760	26275152121204627			-4051	78712

## PINE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG DEG MIN	ELEV +CODE	TEF-008 IN/OUT	NORTH UTM	EAST UTM	OBSV GRAV	THEO GRAV	FAA	CSA +1000
PV0087	383529	1134377	51320	0	106427440	26226151878204382	-4205	78356		
PV0088	383526	1134383	51930	0	104427065	26206151706204084	-3507	78325		
PV0093	383516	1134488	52180	0	107427605	26069151552204810	-3250	78460		
PV0094	383729	1134488	51540	0	116427926	26079152738204764	-3427	79076		
PV0189	382109	1133937	63559	0	344424795	26789143481203258	956	79664		
PV0255	38 830	1134341	65815	0	148422391	26129139426200380	967	78670		
PV0276	38 807	1133938	61844	0	118422475	26867142311200463	51	79077		
PV0320	389000	1133079	68208	0	195424680	26122140711203167	2725	79672		
FL0459	384372	1133110	54215	0	544428392	26093154217205180	54	82104		
WV0071	383332	1133056	59248	0	284426559	281181486802003726	708	80791		
WV0073	382954	1133046	57278	0	182428190	28120151818205022	455	81344		
WV0076	383082	1133168	611437	0	316426563	27958147829203724	1646	81109		
PV0309	38 636	1134272	64320	0	160422177	26224139744200213	314	78448		
PV0246	38 932	1134626	70630	0	298422649	25720127399200574	3305	79513		
PV0264	381232	1133686	66801	0	179423256	27108141071201026	1564	79683		
PV0280	381332	1133875	63750	0	179423337	26837142139201145	2979	80732		
PV0325	381709	1133755	90180	282683484047	27033124639201711	7823	79773			
PV0305	381675	1134322	593707	0	152424378	26215144074201985	-1816	78018		
PV0236	382078	1134436	71158	0	261424840	24505139077200251	2765	79759		
PV0141	382211	1134300	57593	0	122425215	26001146969201554	-2146	78221		
PV0155	382718	1134250	54107	0	110425935	262661490522013151	-3196	78452		
PV0178	382575	1133301	60970	0	484426416	27470147048201556	1130	80753		
PV0105	383188	1135026	62355	0	214426938	252641465702003881	1371	80319		
PV0030	383553	1133405	89157	623153427462	27638124203204432	8721	81519			
PV0051	382875	1133984	51700	0	167428061	26887152405204991	-2331	79203		
FL0084	384347	1134375	54038	0	126423395	26257152386200144	-1962	79717		
PV0083	384212	1134273	58546	0	152428122	262671495172018401	-355	79756		
WV0058	384236	1134375	74455	222153428483	25980136472205502	6127	81060			
PV0082	384377	1134375	66520	10	384429046	26275146062205559	3012	80720		
PV0029	384421	1133701	65919	404	387421095	27255146665115709	2991	81308		
PV0031	384366	1133284	65801	-3671424945	27830125554204015	9063	81112			
PV0032	384357	1133223	65820	421119442674	27448135394201555	4517	81125			
PV0100	384312	1134954	61366	21	314421361	25522140617201550	842	80403		
PV0107	384427	1135115	61408	5	194427254	23147146437204223	1622	80326		
PV0108	384225	1135183	61470	5	577426914	25092139471204026	4380	80091		
PV0133	380823	1133429	62311	0	402421289	27280146127203492	1257	80440		
PV0038	384036	1135514	62177	48	341424138	24473137479200179	5005	79459		
PV0257	38 519	1134451	62187	0	164421594	25971133123201667	1814	78956		
PV0297	38 410	1133633	62037	2	304421401	27145137361195219	1860	79105		
PV0326	381410	1134486	65630	15	364421946	25211133133201273	4618	78831		
PV0327	38 379	1133555	66210	16	188421951	27202138557200356	912	78540		

## PINE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG DEG MIN	ELEV +0000	TER-DEF IN/OUT	NORTH UTM	EAST UTM	DEEV GRAV	THEO GRAV	FAA	CBA +1000
PV0328	38 430	1134606	76370	8	403423744	254401338203000443			5062	79422
SV0321	384110	1133656	66935	13	335428372	24403145039305237			3815	81349
SV0322	383879	1133755	79455	6	830428131	24202137714304597			7033	81340
SV0355	383826	1133006	68065	3	505428017	25325144338304819			3578	80972
SV0356	384071	1134911	62798	31	329428467	25467147383305179			2133	80639
SV0360	384142	1134680	61885	18	264428587	25220148347301384			1307	80479
SV0361	383690	1133069	64279	90	214427749	25230148472304619			3343	80726
SV0371	383376	1133485	70851	2	242427032	24602142149101011			4879	80954
SV0373	383304	1133598	72935	5	351427449	24451141399214343			6188	81690
PV0305	38 239	1133972	64759	0	318421430	26641140145199632			1456	79629
PV0395	38 217	1133806579107		0	146421475	26685144929199673			-242	80153
PV0399	38 409	1133832555997		0	172421684	26624143940199637			-737	79442
PV0304	38 512	1134043	62049	0	142421845	26549141201199959			-356	78616
PV0300	38 514	1133840592197		0	177421841	26842142156199961			-1071	78906
PV0303	38 517	1133987	61623	0	125422019	26635141325300098			-775	78332
PV0301	38 610	1133864598767		0	167422019	269161422749200102			-936	78748
PV0307	38 657	1134142	62593	0	144422119	26412140531300170			-455	78239
PV0302	38 703	1133944	62125	0	118422125	26704141040200238			-732	78196
PV0366	38 731	1134059	63449	0	131422289	26455139544200308			-655	77539
PV0276	38 733	1133849	60900	0	135422283	264451423603200311			-390	78975
PV0244	38 739	1134565	68540	0	191422399	25512130509201375			2642	79455
PV0288	38 835	1133447	64360	0	135422415	27437141406200431			1581	79735
PV0267	38 833	1133699	62032	0	121422474	26632141442200457			-634	78330
PV0265	38 836	1134124	63431	0	131422485	26449140327200462			-425	78062
PV0275	38 837	1133835	61947	0	118422475	26867142213300463			52	79075
PV0287	38 839	1133673	62731	0	123422450	27109141415211490			907	79297
PV0256	38 872	1134015	65131	0	138422557	26238134593201513			369	78297
PV0254	38 875	1134336	65611	0	143422641	26114139714201177			781	78593
PV0292	38 941	1133394	65880	0	147422612	27820140943201556			2264	79941
PV0277	38 950	1133615	63451	0	123422702	26905141594201543			1050	79541
PV0252	38 960	1133951	66004	0	125422708	26665141310201543			-38	78594
PV0264	38 960	1134146	63796	0	125422711	2642414040021543			-258	78126
PV0267	381034	1134035	64367	0	125422820	26267140114201724			27	78204
PV0257	381036	1134040	65397	0	125422825	26114139574201725			494	78329
PV0285	381032	1133540	65668	0	146422823	273121415731321749			1321	79135
PV0269	381079	1134088	63157	0	118422896	26514141514201799			-405	78164
PV0274	381038	1133925	63571	0	124422897	26781142136200794			201	78957
PV0263	381107	1134007	61641	0	125422893	26345141514201829			-349	78302
PV0285	381110	1133957	64719	0	146422917	27101141464101934			1535	79604
PV0246	381122	1134603	69140	0	205422999	25722158041200852			2317	78941
PV0251	381133	1134367	64569	0	127423045	26110140314201697			83	78200

## PINE VALLEY GRAVITY DATA

STATION IDENT.	LAT DEG MIN	LONG DEG MIN	ELEV +0000	TER-COR IN OUT	NORTH UTM	EAST UTM	DESN GRAV	THEO GRAV	FAA	CSA +1000
PV0270	381174	1134086	62426	0	121423072	26522141516200927			-663	78168
PV0273	381185	1133973	62191	0	127423067	26527141994200944			-417	78499
PV0286	381194	1134061	63438	0	127423116	26527140680200937			-577	77916
PV0282	381212	1134123	62627	0	123423145	26411141125200983			-921	77844
PV0250	381227	1134437	64559	0	126423183	26056140146201005			195	78213
PV0247	381236	1134619	67920	0	179423346	25746133989201048			1869	78852
PV0279	381240	1133844	60790	0	144423221	26879142112201052			1097	79484
PV0272	381232	1134020	62091	0	128423269	26524142214201056			-435	78522
PV0259	381239	1134267	63148	0	126423292	26261140353201085			-816	77774
PV0249	381249	1134435	63775	0	1444233410	26022141016201184			-148	78245
PV0261	381257	1134189	62033	0	129423432	26352141482201210			-1357	77619
PV0283	381249	1133601	62570	0	2554233412	27240139784201213			3204	80038
PV0245	381247	1134697	67740	0	1924233510	25642139821201254			1435	78523
PV0271	381246	1134078	61407	0	142423500	25546142299201267			-744	78442
PV0240	381245	1134806	68750	0	220423547	25484139621201290			2062	78621
PV0281	381419	1133937	62495	0	177423319	26723142922201256			452	79315
PV0282	381447	1133871	64080	0	202423366	26850142181201327			1166	79512
PV0260	381431	1134257	61990	0	136423391	26287141578201333			-1303	77621
PV0208	381503	1134476	63997	0	127423557	25970141586201409			-152	78361
PV0195	381521	1134131	61020	0	144423715	26476142862201436			-1123	78214
PV0187	381534	1133935	64450	0	203423750	24762141649201470			840	79066
PV0222	381533	1134762	67109	0	194423857	25558135648201527			1277	78585
PV0194	381534	1134031	62810	0	189423828	26624142090201528			-322	78444
PV0196	381516	1134175	60217	0	161423893	26415143522201575			-1282	78305
PV0207	381524	1134348	61152	0	129423915	26164142742201587			-1292	77990
PV0209	381535	1134472	62151	0	135424035	25979142240201677			-821	78072
PV0221	381712	1134685	63490	0	164424076	25472141251201732			465	78799
PV0193	381720	1134028	63720	0	264424079	26635142038201727			283	78813
PV0197	381722	1134214	59320	0	178424091	26364144103201730			-1789	78154
PV0206	381733	1134266	60650	0	134424173	26145142091201791			-1619	77835
PV0215	381756	1134912	61700	0	129424240	25934142787201829			-982	78109
PV0198	381816	1134715	58781	0	126424285	26388144178201843			-1769	78378
PV0192	381838	1134368	62781	0	314424355	26562147166101900			-235	78457
PV0223	381839	1134479	63702	0	167424372	25547141354201902			1122	79011
PV0210	381813	1134475	60367	0	125424415	26993147692102010			-1609	77912
PV0216	381811	1134630	62051	0	141424455	25769147154301037			-452	78525
PV0199	381837	1134156	58782	0	237424456	26461145105201045			-1064	78914
PV0204	381841	1134325	58811	0	146424455	26215144716201090			-1921	78124
PV0233	381970	1135239	65678	0	242424555	26255157497201094			2969	79454
PV0226	381951	1134850	66004	0	193424598	25452141294202110			1775	79289
PV0191	382017	1134025	62992	0	292424629	26641143562202123			684	79492

## PINE VALLEY GRAVITY DATA

STATION	LAT	LONG	ELEV	TER-COR	NORTH	EAST	DEP.	THEO	FAA	CSA
IDENT.	DEG MIN	DEG MIN	+0000	IN/OUT	UTM	UTM	GRAV	GRAV		+1000
PV0220	382023	1134711	62300	0	147424618	2565714373	1202172		195	79089
PV0211	382024	1134440	59003	0	135424618	2495114460	0020173		-2045	77965
PV0217	382024	1134600	60950	0	138424618	2551814384	1202173		-940	78393
PV0200	382031	1134163	58518	0	135424716	2445714512	0302227		-1435	78301
PV0204	382075	1135272	68284	0	185424790	2484214083	0202248		2852	79749
PV0229	382087	1134973	64180	0	162424818	2527914400	1202280		2121	80403
PV0189	382109	1135937	63950	0	244424795	2675914348	7202298		1002	79671
PV0214	382111	1134482	58781	0	135424822	2559114516	7202301		-1912	78169
PV0203	382112	1134298	57490	0	145424816	2628014534	0202302		-2150	78382
PV0215	382116	1134709	61221	0	135424841	2565514466	0202308		-28	79227
PV0225	382118	1134663	62900	0	149424852	2544014448	6202311		1386	80021
PV0201	382157	1134137	58508	0	180424892	2650014558	9202368		-1435	78696
PV0212	382160	1134531	59360	0	123424954	2594014507	4202402		-1272	78539
PV0230	382157	1134917	62660	0	149425000	2536614443	1202437		1940	80375
PV0212	382158	1134574	57235	0	135424978	2615714505	1202426		-2401	78171
PV0213	382158	1134487	58340	0	124424983	2599314541	1202428		-1921	78236
PV0190	382215	1134048	59508	0	192424995	2663314550	8202453		-946	78952
PV0202	382215	1134224	56478	0	151425004	2636214691	5202453		-2385	78504
PV0233	382216	1135211	66850	0	159425009	2693914521	7202455		2638	79981
PV0231	382226	1135040	70716	0	404425039	2512614014	0202470		4233	80512
PV0224	382232	1134755	60875	0	134425039	2540014653	0202478		331	79704
PV0237	382237	1135387	76851	0	186425096	2466914119	7202485		3326	80099
PV0120	382278	1134941	63715	0	139425151	2533614463	1202545		2049	80478
PV0152	382284	1134358	56900	0	124425136	2619514654	0202555		-2464	78253
PV0175	382302	1133941	58550	0	254425152	2679314659	7202550		-842	79429
PV0131	382310	1134639	58360	0	125425154	2578314652	0202562		-1155	78654
PV0130	382310	1134940	60354	0	131425202	2550114581	0202562		27	79501
PV0164	382310	1134127	58501	0	135425193	2653114487	5202567		-2155	78587
PV0153	382339	1134218	56110	0	133425220	2639214726	7202564		-2512	78466
PV0151	382339	1134353	56470	0	120425273	2617614695	0202563		-2527	78323
PV0119	382339	1134937	63058	0	145425347	2532514543	6202570		2069	80712
PV0132	382354	1134641	58325	0	115425352	2577814638	0202575		-1337	78751
PV0129	382356	1134855	60515	0	135425353	2546814513	0202574		205	79987
PV0165	382414	1134037	55402	0	137425363	2655414804	5202585		-2195	78940
PV0142	382426	1134478	57100	0	116425404	2601814557	0202582		-2144	78496
PV0174	382437	1133524	56191	0	223425459	2698314815	1202572		-1429	79674
PV0128	382446	1134771	55525	0	127425458	2559314744	0202565		-311	79516
PV0163	382457	1134161	53480	0	127425445	2645114771	9202565		-2912	78125
PV0150	382458	1134349	55325	0	117425452	2650014571	0202563		-2601	78247
PV0171	382459	1134935	61720	0	143425539	2535514679	9202554		1334	80426
PV0112	382453	1135090	63950	0	183425555	2513114499	7202561		2265	80637

## FINE VALLEY GRAVITY DATA

STATION IDENT.	LAT DEG MIN	LONG DEG MIN	ELEV +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM	GEEN GRAV	THEO GRAV	FAA	C24 +1000
PV0133	382511	1134618	57740	0	113425568	35819147070303988	-1476	78942		
PV0166	382519	1133998	54691	0	167425556	26720149042203559	-3337	79125		
PV0143	382526	1134456	56324	0	111425582	26056147776201409	-2128	78774		
PV0154	382544	1134272	54481	0	1134255614	26324148468202932	-3191	78346		
PV0173	382557	1133856	55094	0	213425519	26460149412102955	-1696	79727		
PV0127	382572	1134763	59084	0	123425687	25512146770302977	-606	79369		
PV0162	382586	1134155	548107	0	114425586	26497148062301998	-3332	78027		
PV0149	382597	1134366	55299	0	110425697	26187146353302499	-2609	79544		
PV0118	382602	1135009	61906	0	163425753	25255146183302021	1421	80493		
PV0122	382612	1134891	60064	0	140425767	26438146681303036	362	80021		
PV0140	382623	1134570	56954	0	111425773	25855148036203052	-1419	79269		
PV0167	382645	1133995	54230	0	140425789	26733149097203084	-2979	78673		
PV0148	382648	1134411	55346	0	108425812	26128148674203088	-2333	78901		
PV0134	382656	1134697	57855	0	113425855	25713147683203115	-926	79400		
PV0161	382677	1134135	543117	0	110425854	26330148540203131	-3474	78106		
PV0115	382701	1135060	62164	0	263425939	25187146374203136	1615	80677		
PV0176	382709	1133763	55494	0	203425957	27074149682203178	-1273	80010		
PV0147	382718	1134382	54780	0	107425940	26174148941203131	-2696	78727		
PV0123	382725	1134884	60058	0	146425975	25441146970203202	286	79950		
PV0139	382730	1134532	55935	0	114425970	25927149083303219	-1469	79562		
PV0172	382737	1133883	53704	0	163425964	264901150478203220	-2203	79643		
PV0165	382737	1134046	53540	0	114425961	26664145064303230	-3488	78264		
PV0135	382755	1134666	56918	0	113426040	25763148435203260	-1265	79444		
PV0124	382772	1134821	59658	0	134426059	25538147320203270	-563	79499		
PV0114	382798	1135035	62024	0	202426099	25328145634203284	1552	80361		
PV0158	382799	1134162	53605	0	106426065	26454149145103257	-3306	78518		
PV0146	382794	1134813	54158	0	107426102	26177149671203313	-2632	78992		
PV0160	382826	1134051	533797	0	105426146	26604149652703353	-3776	78126		
PV0138	382836	1134522	53098	0	113426153	25975149690203365	-1967	79355		
PV0126	382840	1134728	57351	0	124426191	25677148124203370	-1172	79371		
PV0177	382853	1133784	54414	0	170426185	27044149053203389	-1631	79922		
PV0169	382857	1133931	53712	0	111426179	2680915002103395	-3094	78685		
PV0117	382874	1134925	59715	0	164426155	25382147441203420	276	80054		
PV0145	382879	1134369	53651	0	106426238	26175150325103437	-2421	79315		
PV0157	382887	1134374	53354	0	103426248	26337150341703479	-2914	78993		
PV0136	382910	1134428	56114	0	123426307	25798149135103473	-1311	79671		
PV0159	382942	1134047	531407	0	107426394	26643149700303491	-2968	78083		
PV0119	382950	1135004	61461	0	169426364	25291146955303505	1204	80443		
PV0171	382956	1133841	57394	0	111426321	26973150697203511	-2673	79363		
PV0125	382942	1134470	56017	0	131426371	25656148455703520	-1295	79531		
PV0137	382954	1134505	54123	0	113426351	26008150337203545	-2274	79279		

## PINE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG DEG MIN	ELEV +0000	TER-COR IN/OUT	NORTH UTM	EAST UTM	OBSV GRAV	THEO GRAV	FAA	CBA +1000
PV0116	392976	1134987	52675	0	159426440	254541481	12203570	-221	79920	
PV0170	382979	1133943	52680	0	129426404	268261505	95203574	-3402	78760	
PV0155	382979	1134162	52681	0	102426414	265081498	54203574	-4011	78076	
PV0144	382979	1134384	52682	0	105426423	261851511	12203574	-2254	79655	
PV0039	383054	1133638	52942	0	238426493	273731498	54203655	-213	80594	
PV0312	383052	1134611	54575	0	119426565	255591504	75203681	-1850	79657	
PV0104	383052	1134951	61025	0	183426584	253221471	95203681	944	80314	
PV0072	383059	1134272	52470	0	102426566	263531507	68203692	-3525	78674	
PV0090	383060	1134494	53580	0	110426578	260311503	74203694	-2394	79441	
PV0056	383065	1134053	52450	0	108426569	266711502	29203701	-4111	78102	
PV0316	383065	1134772	56595	0	142426599	256251492	22203701	-1217	79624	
PV0040	383066	1133831	53160	0	152426561	269941511	06203702	-2566	79454	
PV0103	383114	1134828	58415	0	167426595	254601485	22203773	-279	79966	
PV0311	383149	1134527	53213	0	110426744	259271511	65203824	-3572	79323	
PV0055	383152	1133943	52210	0	129426724	268351511	90203828	-3501	78820	
PV0072	383152	1134161	52220	0	101426734	265191503	37203828	-4347	77944	
PV0089	383152	1134383	52405	0	104426743	261961513	70203828	-3145	79027	
PV0038	383154	1133722	53998	0	234426719	271571516	01203831	-1420	80390	
PV0097	383157	1134799	56738	0	157426771	255921492	74203836	-1169	79639	
PV0315	383181	1134628	54425	0	130426810	257531504	61203871	-1946	79534	
PV0074	383239	1134271	51565	0	100426899	263641510	05203956	-4051	78327	
PV0091	383239	1134494	52525	0	113426909	260401517	06103956	-2523	79377	
PV0041	383240	1133833	52130	0	177426883	270001524	63203958	-2444	79956	
PV0057	383240	1134054	52032	0	106426892	266791506	56203958	-4336	78024	
PV0098	383240	1134770	55420	0	142426923	256391499	41203958	-1482	79621	
PV0102	383240	1134918	59015	0	167426929	254241483	47203958	-73	79967	
PV0312	383249	1134631	53615	0	121426970	258421511	18204000	-2429	79407	
PV0054	383256	1133943	51895	0	136427046	268451519	56204084	-3332	79119	
SVS070	383316	1135356	66150	0	199427108	247921450	38204084	3215	80852	
PV0037	383327	1133723	54250	0	251427039	271651517	85204085	-1244	80503	
PV0106	383331	1135032	60629	0	174427103	252631478	36204091	798	80297	
PV0099	383317	1134819	56185	0	138427123	255741499	55204115	-1287	79659	
SVS064	383357	1135181	62178	0	177427155	250481464	95204130	1824	80455	
PV0314	383407	1134662	54055	0	119427227	256051515	71204203	-1765	79919	
PV0092	383413	1134455	52835	0	106427231	260481514	35204212	-3058	79029	
PV0033	383414	1133612	56135	0	318427195	273301495	36204213	129	80621	
PV0058	383414	1134054	51680	0	109427214	266891515	46204213	-4031	78451	
PV0075	383414	1134273	51565	0	101427223	263701514	15204213	-4273	78243	
PV0042	383415	1133833	52965	0	180427206	270101523	99204215	-1925	80132	
PV0101	383454	1134916	56780	0	160427325	254391500	27204272	-619	80096	
SVS063	383526	1135198	63135	0	146427471	250341462	50204378	1285	79902	

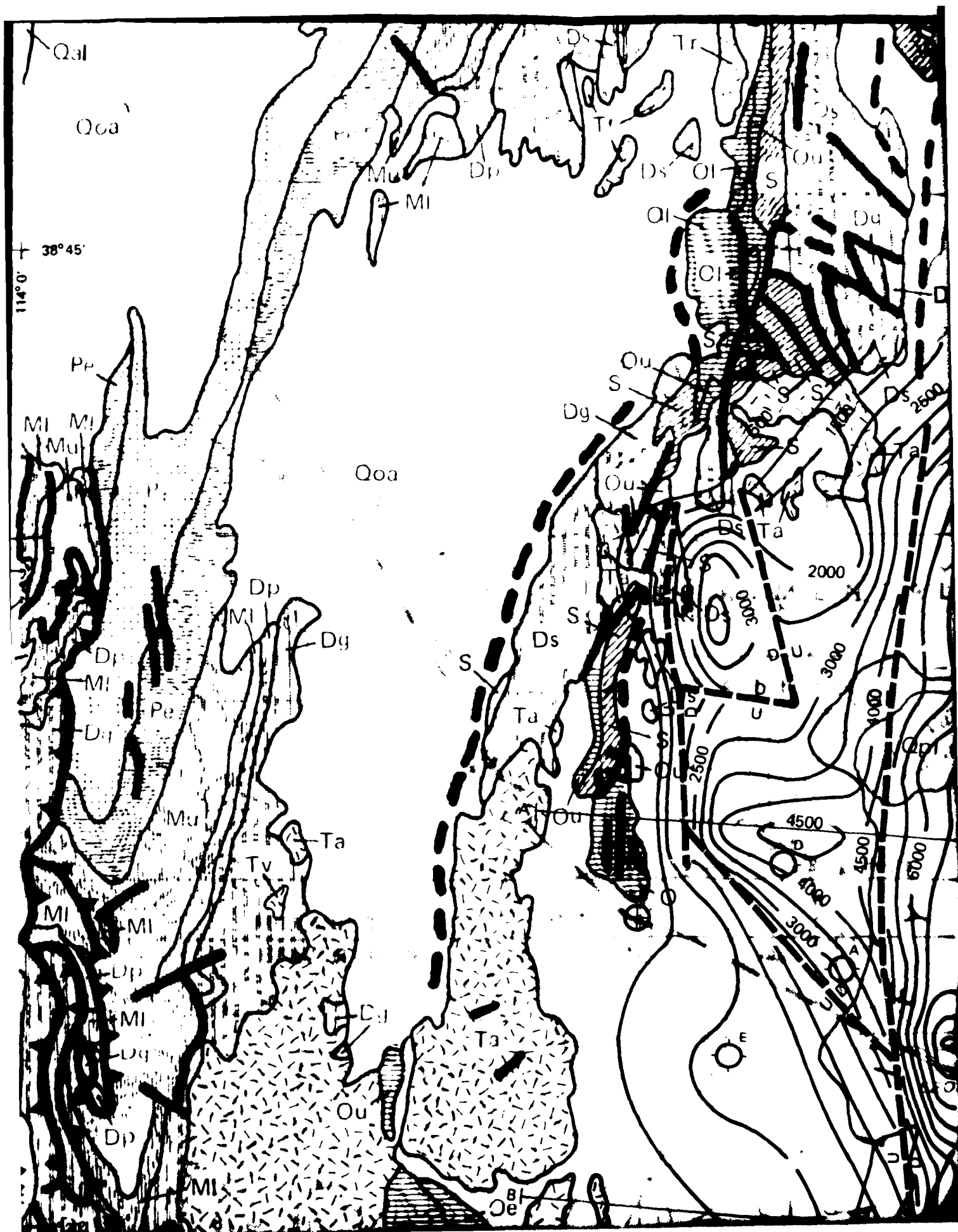
## PINE VALLEY GRAVITY DATA

STATION IDENT.	LAT. DEG MIN	LONG DEG MIN	ELEV +0000	TER-COR. IN/OUT	NORTH UTM	EAST UTM	OBSV GRAV	THEO GRAV	FAP	CRA +1000
PV0036	383528	1133716	55699	0	30427410	27185151110204321	-855	80452		
PV0070	383528	1134155512907		0	109427429	26345151552204281	-4495	78127		
PV0043	383515	1133922	53448		255427575	27036152817271559	-2340	80030		
PV0059	383515	1134044	51215	0	118427585	26714151841204509	-4475	78174		
PV0076	383515	1134265	50578	0	105427595	26392152219204509	-4375	78379		
SVS068	383518	1135485	66320	0	153427654	24622145094204513	3679	81352		
SVS062	383520	1135210	61998	0	139427664	25022147089204520	807	79235		
SVS067	383718	1135312	60331		140427832	24875146592204520	1527	80427		
SVS045	383725	1135183	61448	0	133427913	25065147373214719	615	79724		
SVS031	383777	1135471	64725	0	193427948	24552147420204747	3625	81720		
PV0034	383759	1135601	60353	0	527427829	27365148944204764	1017	80945		
PV0060	383759	1134045	50769	0	130427907	26722152764204764	-4220	78557		
PV0077	383759	1134265	50769	0	112427916	26401152925204764	-4069	78730		
SVS032	383818	1135305	62135	0	134428072	24855148084204852	1707	80535		
SVS046	383850	1135131	60759	0	135428085	25150148254204859	629	80033		
SVS030	383857	1135430	62235	0	131428168	24718148221204923	2903	81454		
PV0045	383922	1135823	53980	0	220428218	27053152495205019	-1722	80097		
PV0095	383963	1134487	53650	0	117428248	26090152176205030	-2357	79422		
SVS047	383970	1135079	60225	0	115428187	25222148553205030	199	79779		
SVS023	383972	1135325	63480	0	165428311	24581146407215034	3120	81233		
SVS033	383978	1135374	60487	0	115428311	24949149147201042	1009	80501		
SVS074	383996	1135259	61139	0	124428348	24829149297205069	1762	81040		
PV0050	384018	1131922	53382	0	166428381	26900152237205145	-2765	79225		
SVS044	384019	1135152	59308	0	105428435	25130149025205147	-311	79570		
SVS034	384077	1135575	62959	0	165428509	24514148451275159	2550	81245		
SVS034	384119	1135357	59755	0	113428555	24532151334205234	1324	81065		
SVS075	384119	1135502	60440	0	131428509	24425149750275270	1611	81052		
PV0074	384135	1134354	54490	0	134428555	26423151581705273	-2313	79239		
PV0046	384136	1135821	56390	0	316428540	27025151524205275	-590	80397		
PV0062	384136	1134943	52444	0	137428559	267431522302715275	-2750	79135		
PV0096	384136	1134485	57159	0	173428555	26101150621271575	-2329	79526		
PV0143	384138	1135219	52111	0	107428605	25324150122311277	115	80752		
SVS052	384170	1134921	59518	0	109428555	26438149742215715	25	79827		
SVS048	384172	1135183	58542	0	114428562	25235149442215524	-793	79181		
SVS025	384182	1135424	58107	0	111428695	24744150271271542	1201	81121		
PV0020	384193	1135593	60431	0	140428705	24455151101271544	1637	81155		
PV0048	384223	1135972	58180	0	152428705	24909152231271402	-1241	80051		
SVS042	384224	1135123	59589	0	107428767	2314914771221407	-252	79623		
SVS039	384255	1134267	59215	0	108428794	2459415111221407	312	80555		
SVS057	384271	1135315	61675	0	140428832	25527148522710473	1125	80295		
SVS026	384272	1135499	60511	0	112428768	2454015148527575	536	80945		

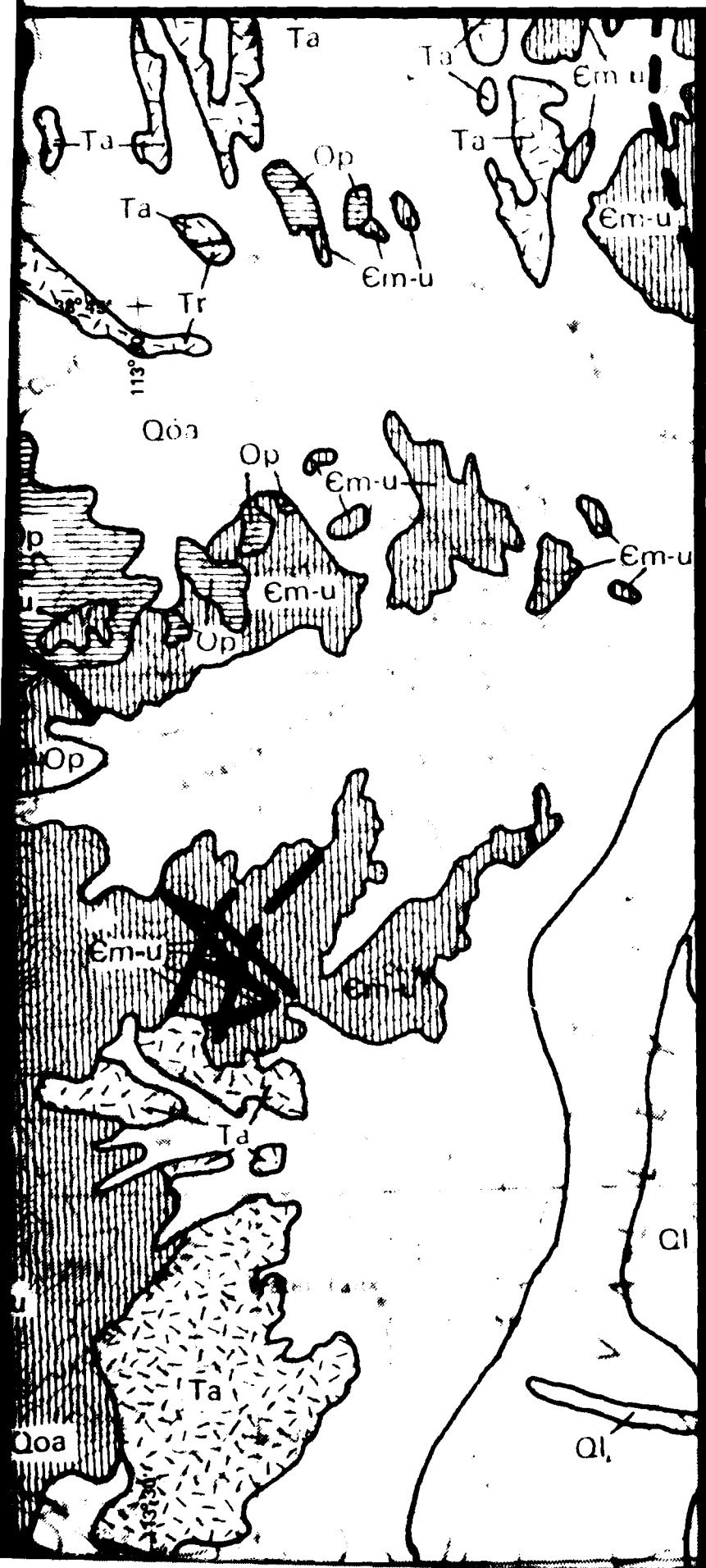
## PINE VALLEY GRAVITY DATA

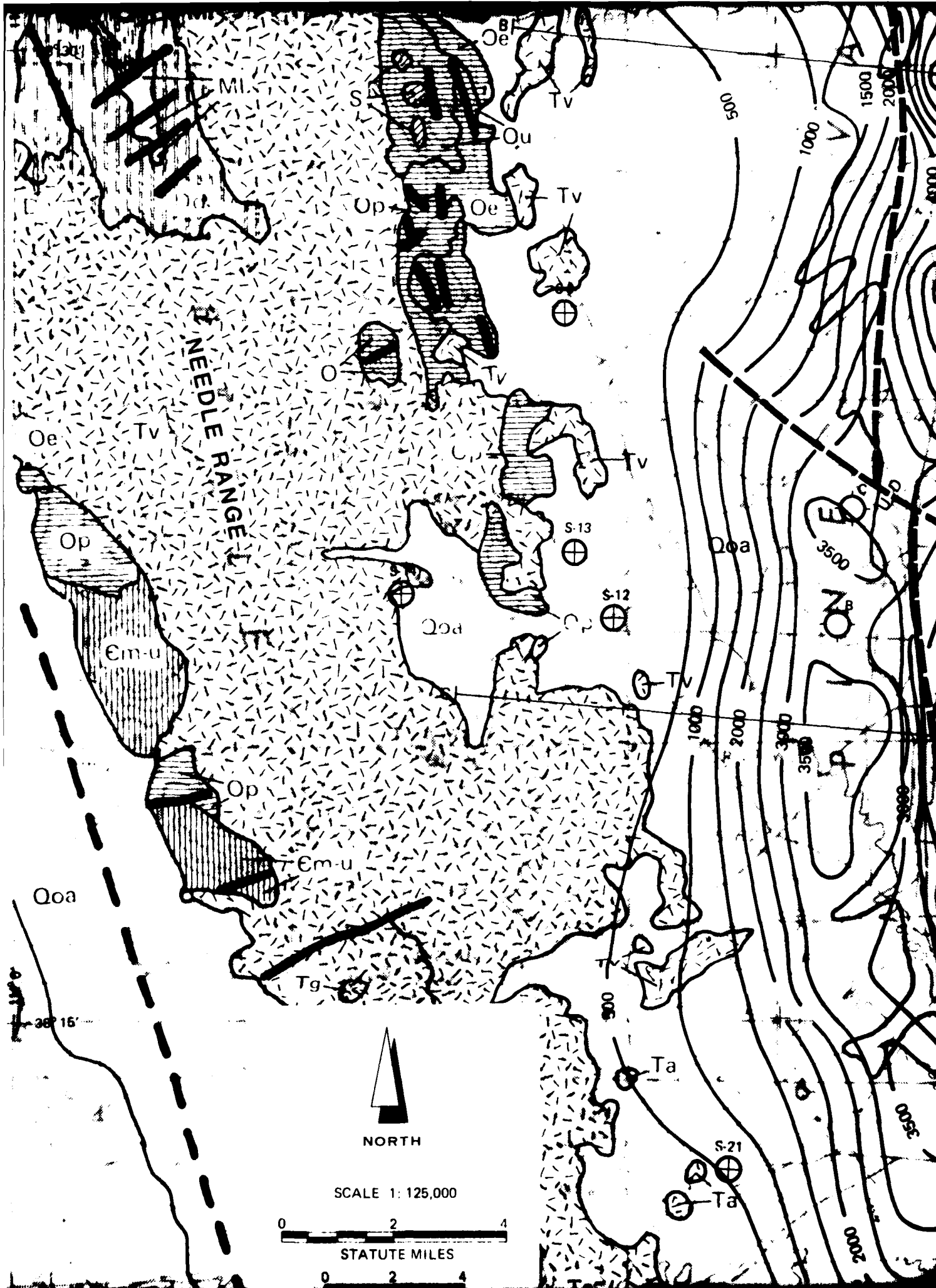
STATION IDENT.	LAT DEG MIN	LONG DEG MIN	ELEV +0000	TER-DEF IN/OUT	NORTH UTM	EAST UTM	GRAV GRAV	THEO GRAV	FAA	CSA +1000
SVS052	384276	1134846	59968	0	118428847	25442148872205480			-177	79490
SVS035	384276	1135370	57778	1	111428866	24828151585305480			474	80681
FV0047	384310	1133822	57398	0	157428861	27073151373205530			-185	80438
SVS049	384310	1135041	59738	0	107428914	25306149543205530			227	79962
SVS051	384358	1134959	60738	0	119428999	25428149127305600			683	80026
SVS037	384359	1135322	58515	0	107429018	24901151254205600			827	80742
SVS027	384354	1135478	57632	0	123429034	24676151807205610			432	80895
SVS041	384359	1135124	60068	1	104429025	25189151012205610			939	81357
SVS019	384356	1135922	60228	0	127429098	246141511354205637			1389	80785
SVS058	384358	1134816	60358	0	171429067	25633147532205660			1492	80060
SVS038	384428	1135352	59318	0	111429147	24853150986205704			1102	80984
SVS050	384470	1135009	61566	0	118429209	26362149219205766			1485	80573
SVS040	384482	1135125	60748	0	116429229	25108150203205784			1583	80925
FV0081	384424	1134264	62319	0	222429202	26442148428205787			1346	80216
SVS023	384578	1135274	604897	0	118429311	249491491482058048			1017	80311
SVS035	384602	1135314	58438	0	1064295727	249041509262058372			543	80723
SVS054	384078	1135016	59218	0	116429484	25329149068205190			-396	79325
SVS065	383478	1135325	64720	0	163427425	24842145420204837			2007	80095
SVS066	383503	1135334	63528	0	152427620	24841146391204491			1694	80177
SVS067	383515	1135453	66710	0	184427444	24659145275204647			3716	81147
TL0448	384484	1133049	55515	0	94424182	26204163569205787			219	81246
TL0449	384347	1133137	56355	0	110428995	26041153100205655			474	81364
TL0450	384484	1133269	57865	0	110429161	27884152354205787			939	81417
TL0451	384484	1133489	61259	0	154429170	27565150046205787			1926	81189
TL0452	384547	1133380	59439	0	125429004	27718151074205659			1348	81317
TL0453	384310	1133269	57868	0	136428879	27575152107205631			954	81345
TL0454	384310	1133046	55689	0	111428931	25193152354205631			271	81391
TL0455	384224	1133360	60262	0	206428564	27709150229205404			1539	81182
TL0457	384030	1133380	62639	0	212428363	27700148514205449			2313	81169

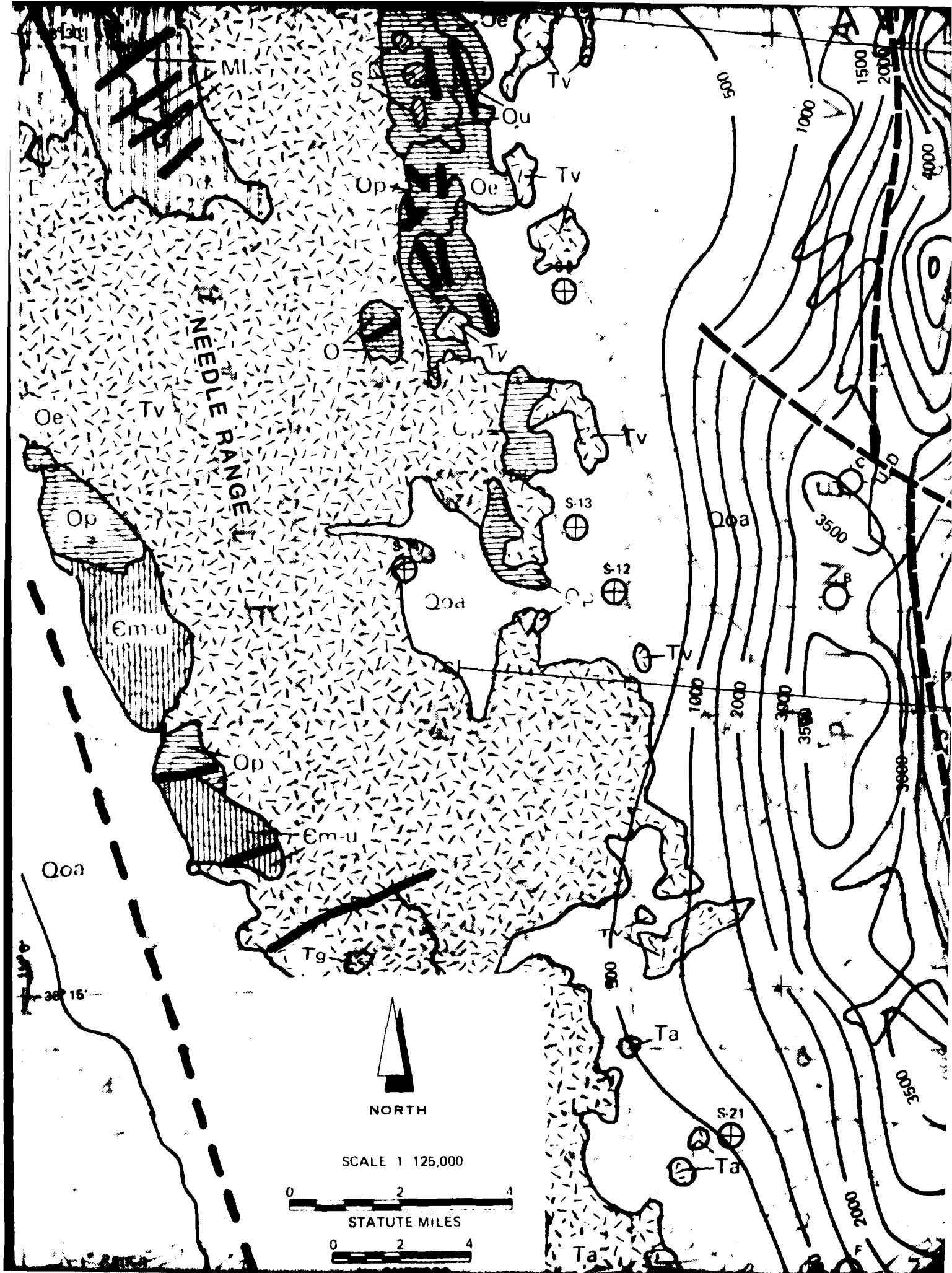
END OF LIST



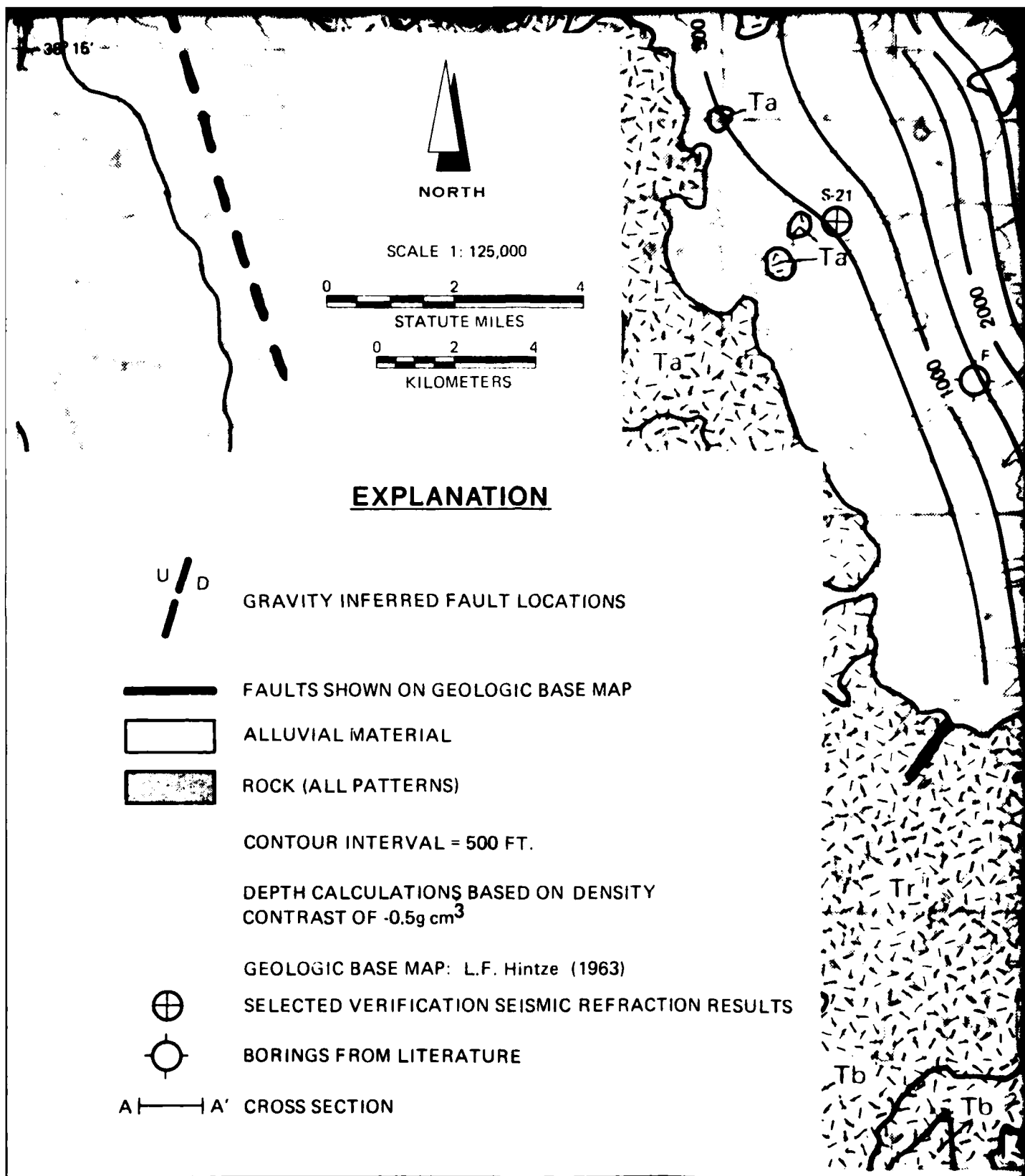


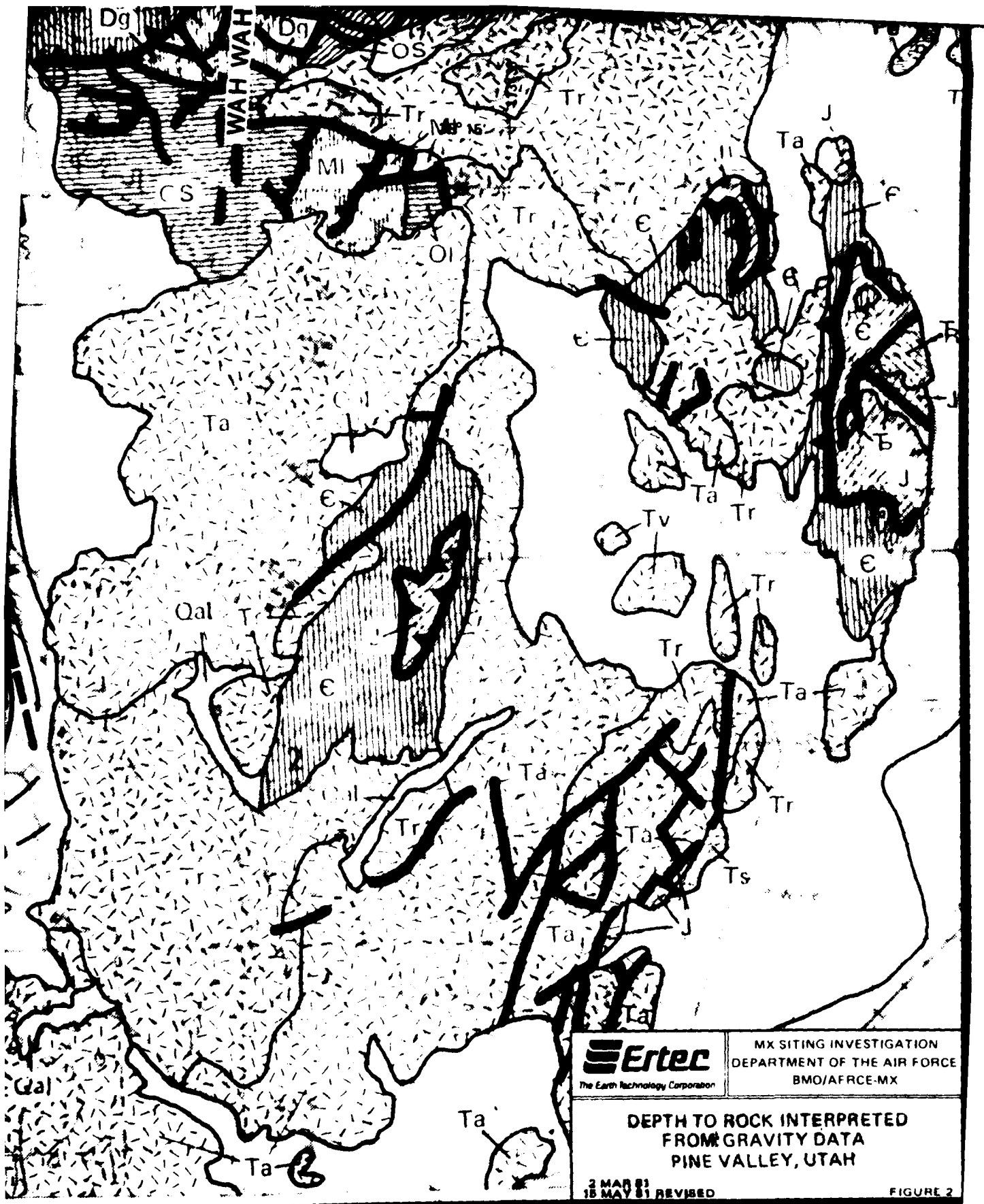




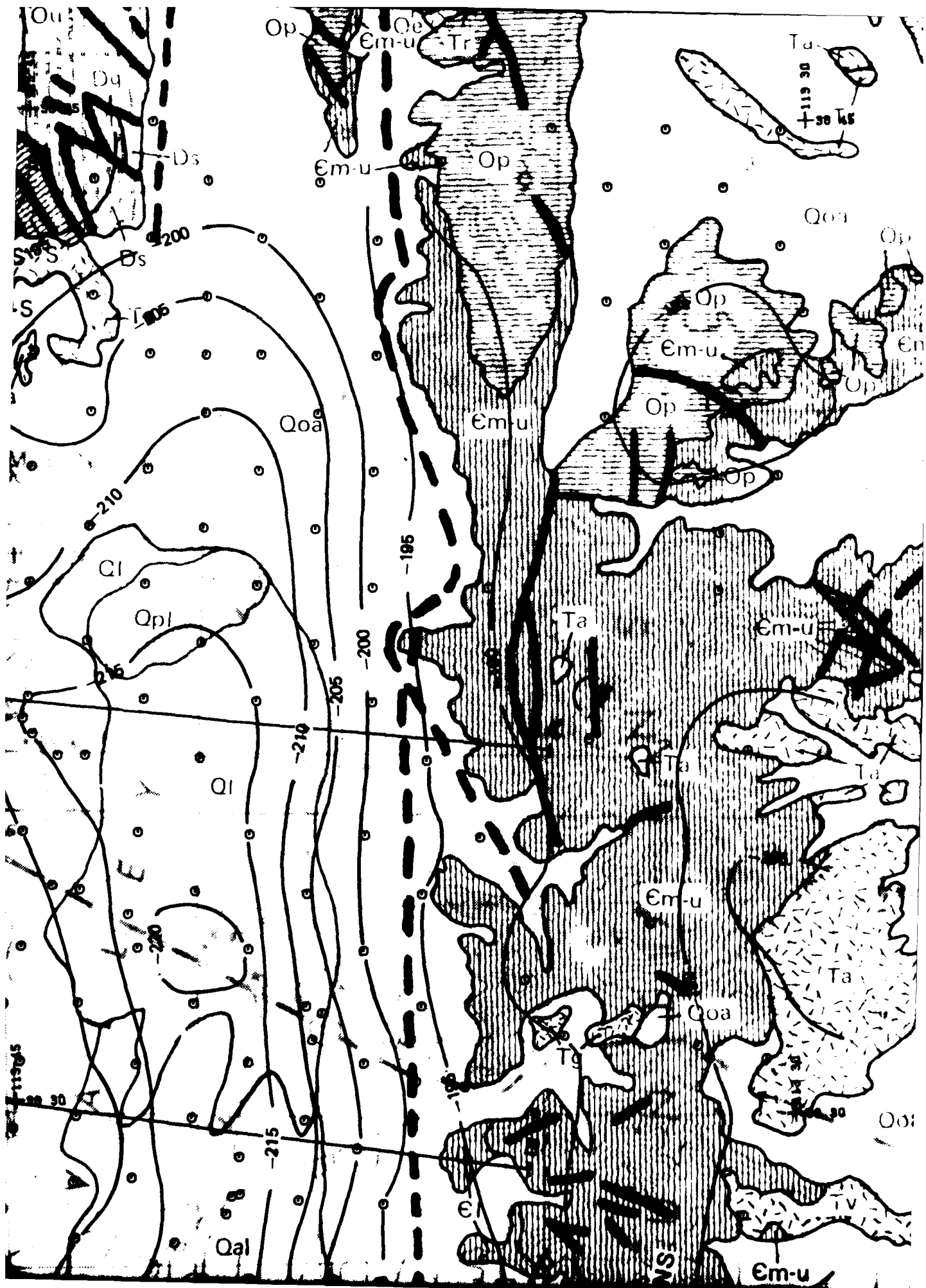


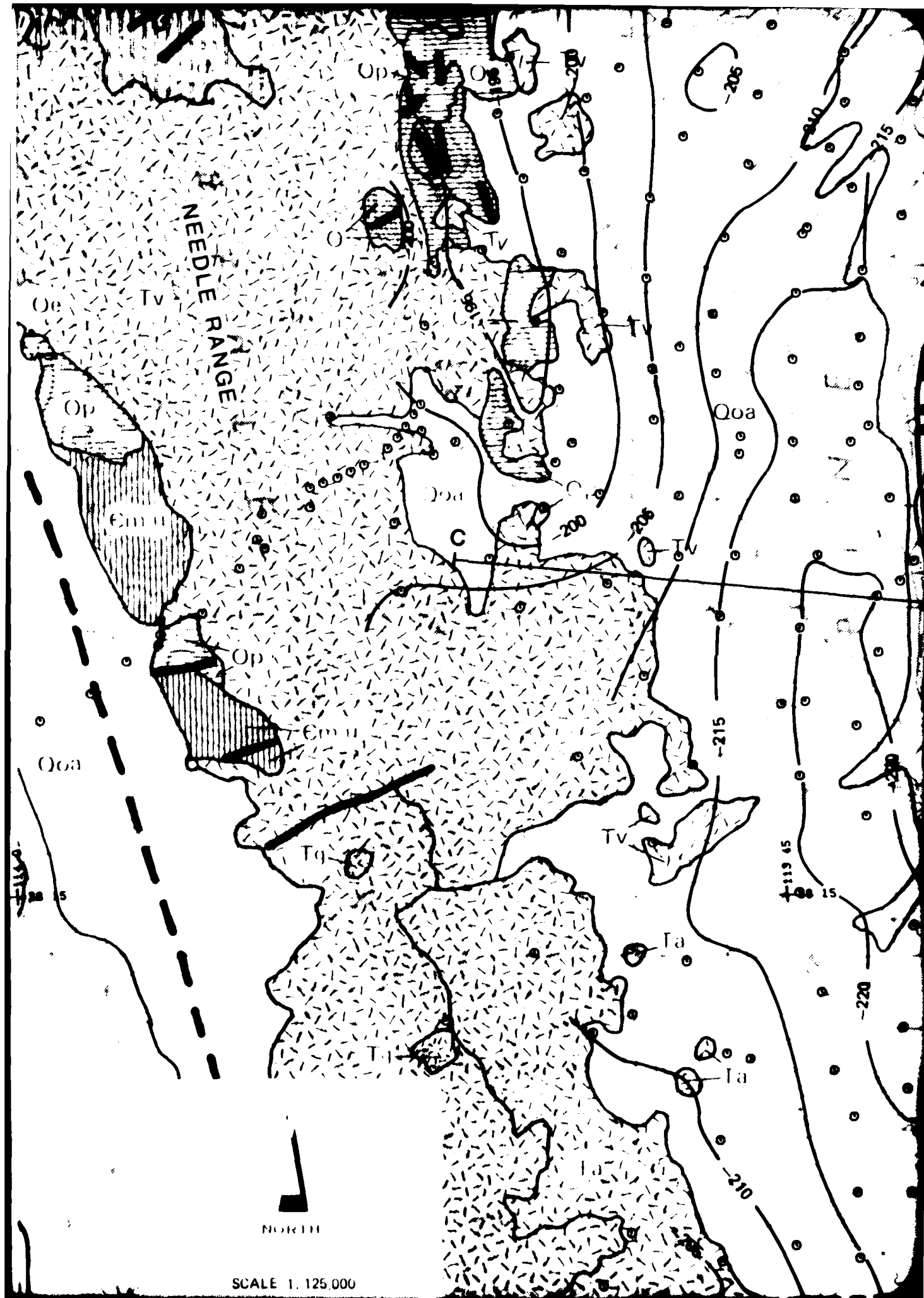


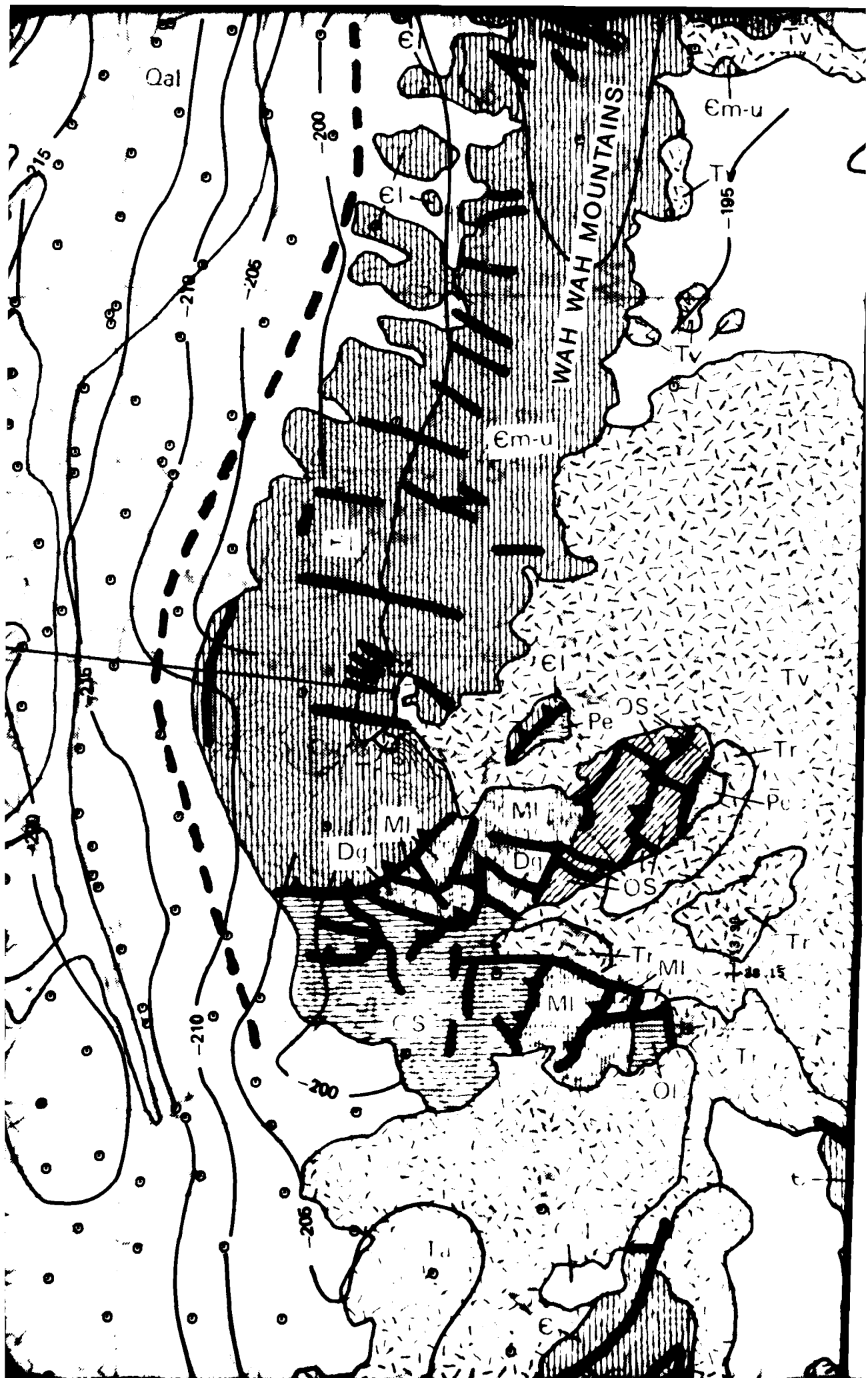


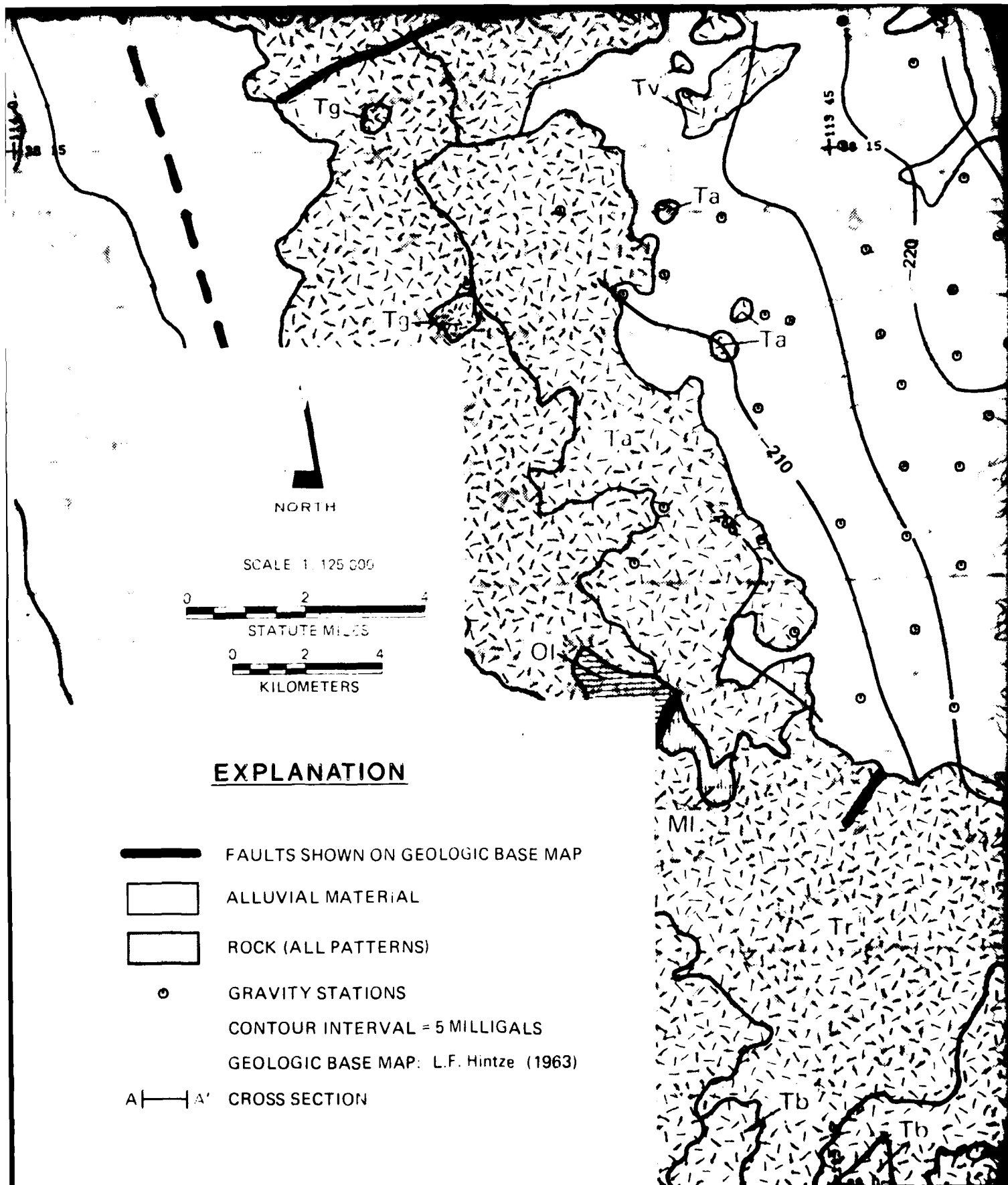


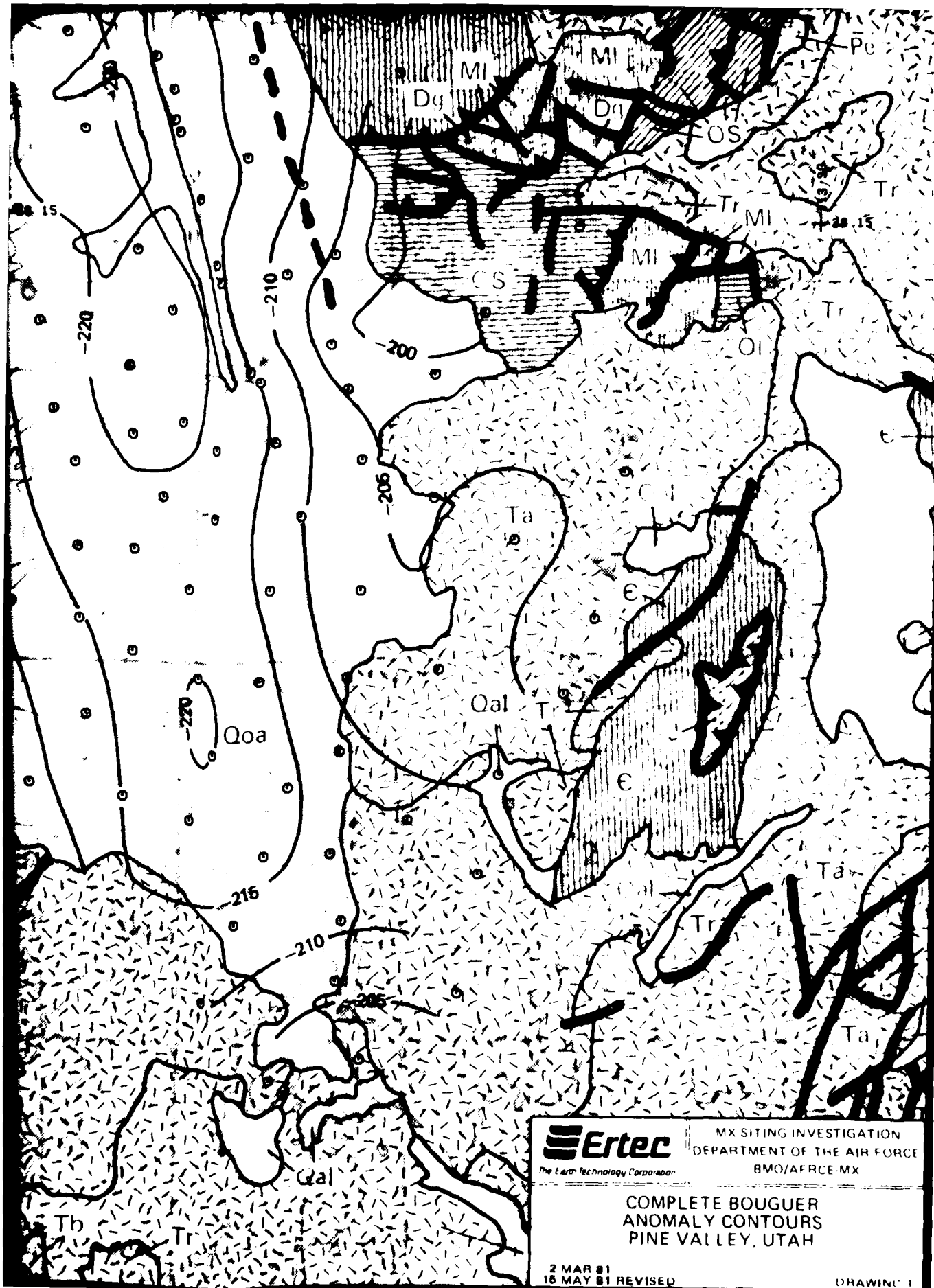












**EN  
DATE**